FLIGHT SIMULATOR® 5

STRATEGIES AND SECRETS

JOSEPH R. LEVY

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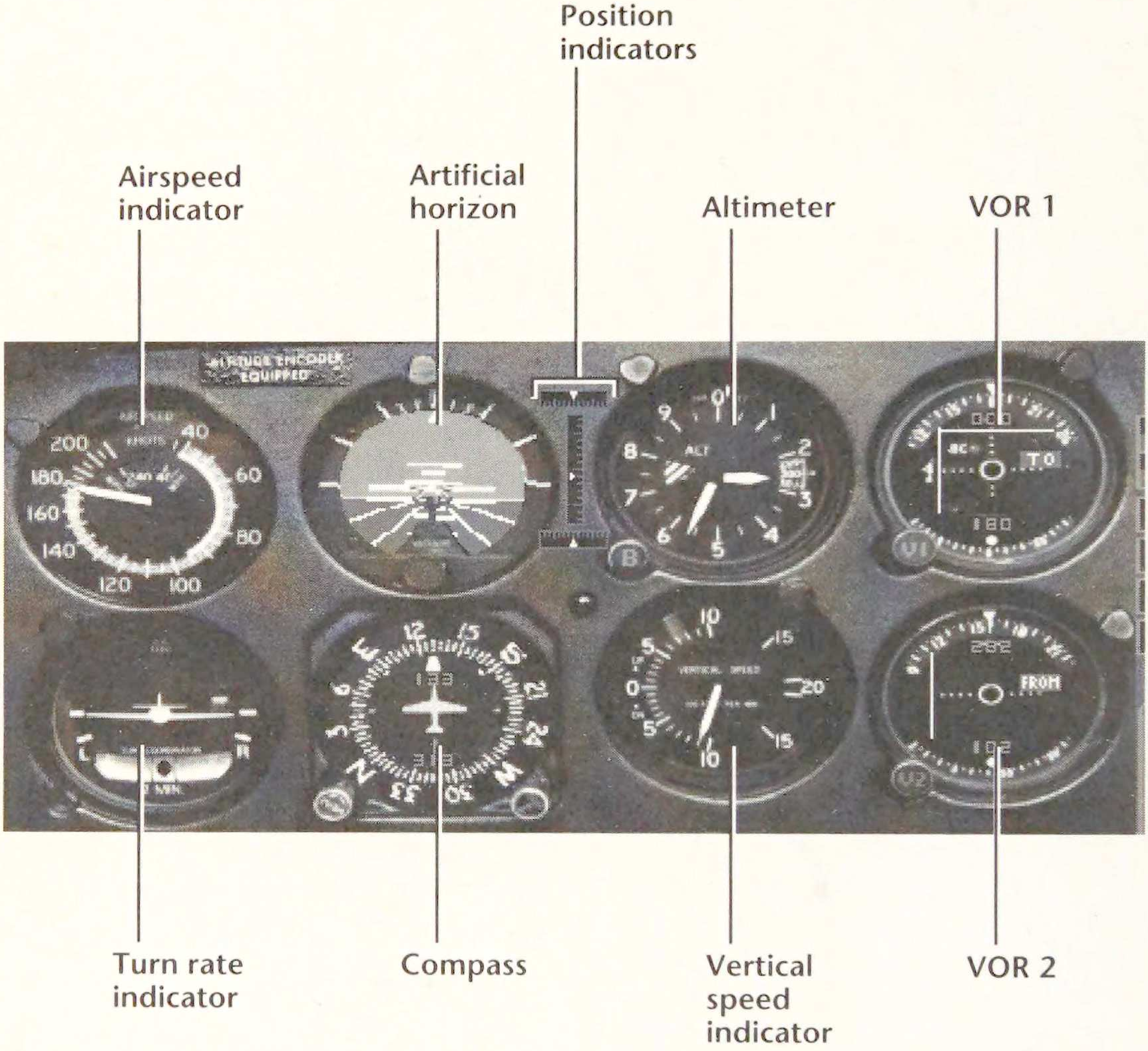
MASTER THE FUNDAMENTALS OF FLYING IN THE PRIVACY OF YOUR OWN HOME

INCLUDES A RESOURCE GUIDE TO ADD-ON PROGRAMS, BULLETIN BOARDS, AND MORE

WRITTEN UNDER THE GUIDANCE OF A CERTIFIED FLIGHT INSTRUCTOR

SYBEX

The Cessna Cockpit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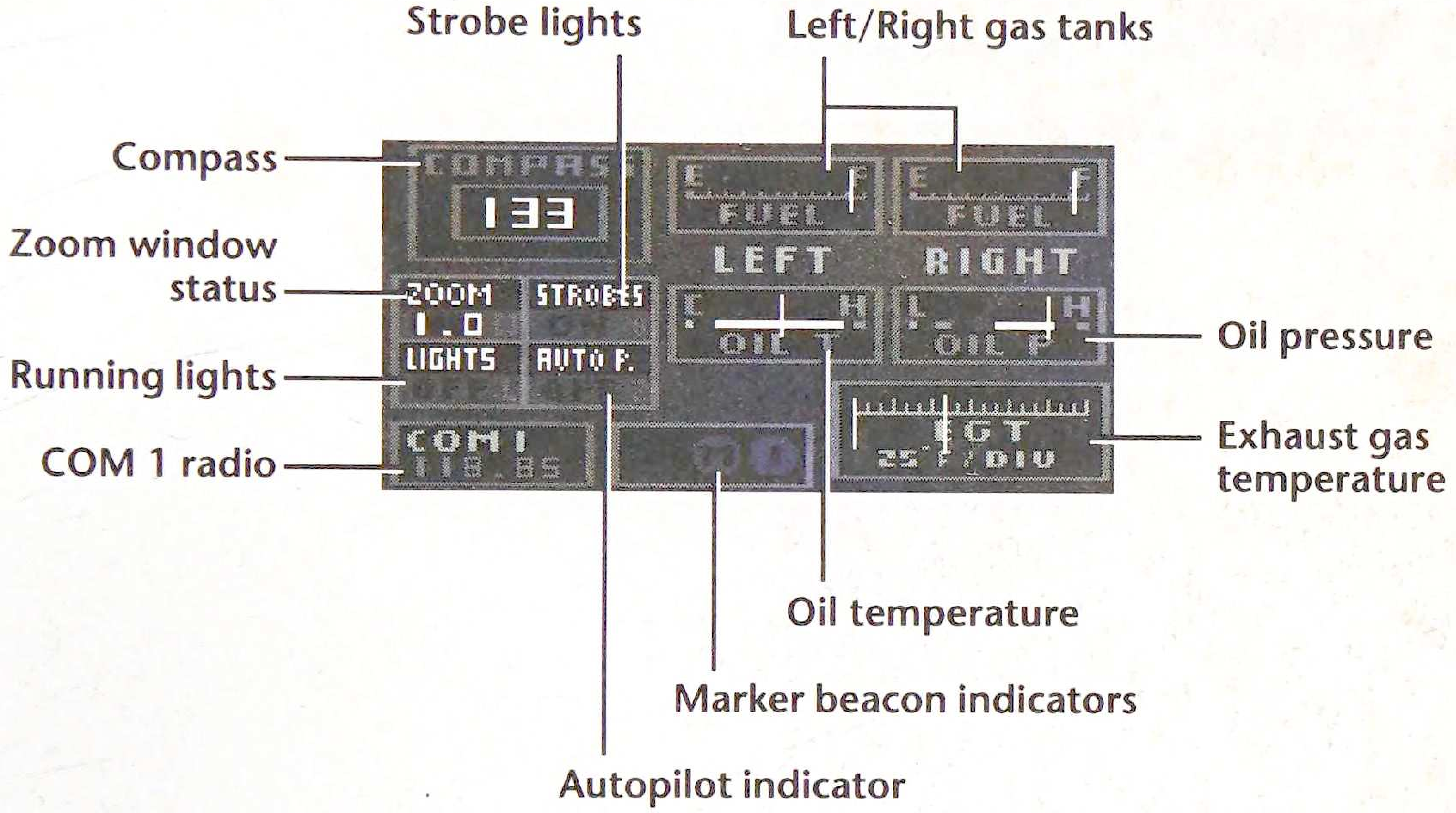
Airspeed indicator
Artificial horizon
Altimeter
VOR 1
ALTITUDE ENCODER EQUIPPED
Turn rate indicator
Compass
Vertical speed indicator
VOR 2


Strobe lights
Left/Right gas tanks
Compass
Zoom window status
Running lights
COM 1 radio
Oil pressure
Exhaust gas temperature
Oil temperature
Marker beacon indicators
Autopilot indicator
COMPASS
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FUEL
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STROBES
LIGHTS
AUTO P.
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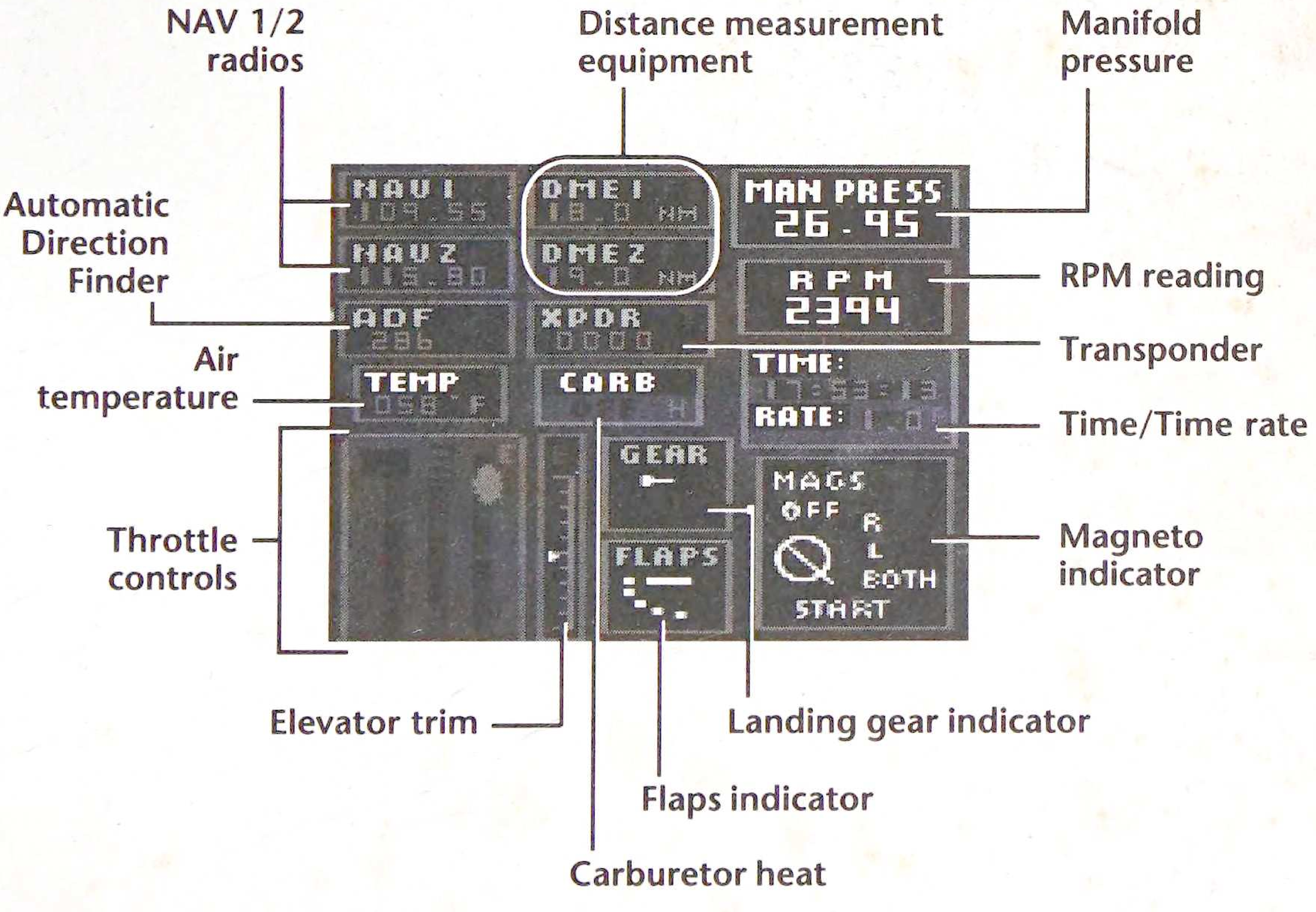
NAV 1/2 radios
Distance measurement equipment
Manifold pressure
Automatic Direction Finder
Air temperature
Throttle controls
RPM reading
Transponder
Time/Time rate
Magneto indicator
Elevator trim
Landing gear indicator
Flaps indicator
Carburetor heat
NAV 1
109.55
NAV 2
115.80
DME 1
18.0 NM
DME 2
19.0 NM
MAN PRESS
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RPM
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Flight Simulator 5

Strategies and Secrets

• • • Flight Simulator® 5

Strategies and Secrets

Joseph R. Levy

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This book is dedicated to the memory of Ms. Louise Nichols, my lifelong friend who never stopped believing in me.

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• • • Introduction

This book is written with an attitude, that attitude being that anything worth doing is worth doing well. Flight Simulator is not a program for the faint of heart or the feeble-minded. It is a demanding program, literally a world unto itself. If you want to master that world, you've come to the right place.

This book is packed with strategies and secrets for making your flights more enjoyable. With the advice and hands-on instructions in this book, you'll not only become a better pilot, you'll learn the basics of aerodynamics and the real-life procedures pilots use, for example, to land their planes, communicate with the control tower, and take off.

• • How This Book Is Organized

The book is divided into three parts:

- Part One, "Ground School," shows you how to read the Flight Simulator instruments, how to navigate, and how to control the plane with the mouse, joystick, and keyboard. It includes a discussion of basic aerodynamics and gets you acquainted with Flight Simulator's many menu commands.
- Part Two, "Flying," shows you how to take off and land, turn the airplane, use autopilot, and communicate with the control tower.

- Part Three, "The Wild Blue Yonder," delves into trick flying and shows you how to control the weather, the scenery, and other elements of Flight Simulator in case you want to try especially challenging flights.

The appendices in the back of the book explain the differences between Flight Simulator Versions 4 and 5, list commercial and shareware add-ons for the program, and tell you where to go if you need more information. A glossary is also included to help you understand flight terminology.

Conventions Used in This Book

This book is designed to give you the information you need as quickly and as clearly as possible. You will find step-by-step instructions where necessary, and lots of figures to illustrate important information.

To help you learn the program quickly, the book also includes Tips, Warnings, Notes, and information specific to Version 5.

TIP *The Tip icon: Where you see this icon, information is provided to help you use the program more efficiently. Tips give you shortcuts and other "inside information" to make you an expert Flight Simulator pilot.*

WARNING *The Warning icon: Where you see this icon, watch out! Warnings tell you when you are in danger of crashing and how to avoid dangerous situations.*

NOTE *The Note icon: This general-purpose icon marks passages that refer you to other parts of the book for further information. A note might also tell you the meaning of a term. Notes are reminders that tell you how to use the program better.*

The New icon: This icon appears where features new to Version 5 of Flight Simulator are discussed. If you've been using Version 4, pay special attention to the New icon. (Appendix A explains all features new to Version 5.)

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Conventions Used in This Book

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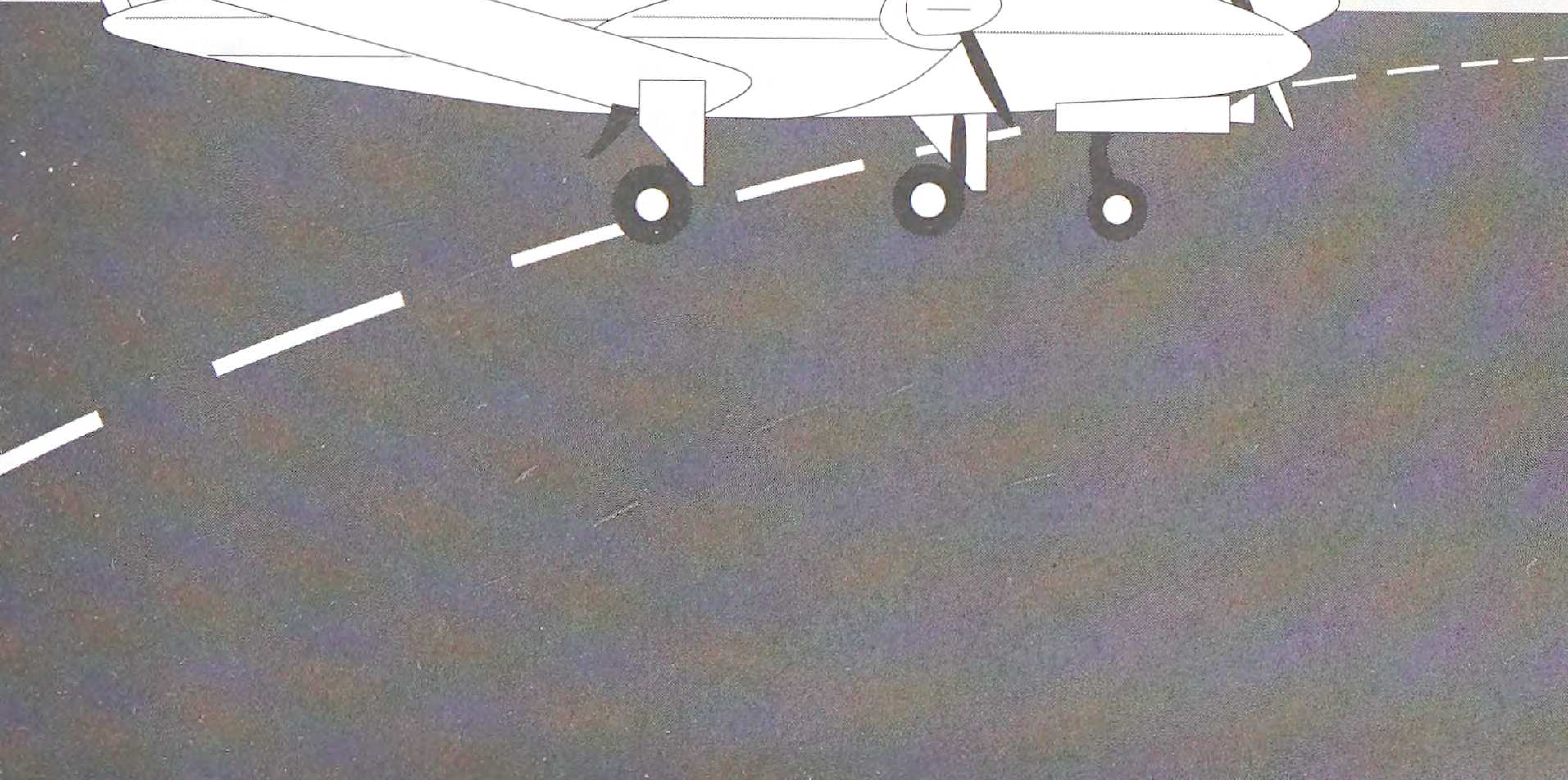
PART ONE

• • • GROUND SCHOOL



1

Installing and Starting Flight Simulator

The first part of this step describes how to install Flight Simulator. If you have already installed the program, go to "Starting Flight Simulator" later in Step 1. Following are directions for installing the program, choosing a display mode, choosing where to install Flight Simulator, and configuring the program. At the end of this step are directions for taking a quick test flight.

• • Installing Flight Simulator

WARNING *You should know your system's configuration before you install Version 5.*

To install Flight Simulator on your hard disk:

1. Start MS-DOS.
2. Insert the first Flight Simulator installation disk into drive A or B.
3. Type **a:setup** or **b:setup** at the DOS prompt and press Enter to start the installation procedure.

Choosing a Display Mode

The first installation menu asks you to select which type of display resolution you would like to use. The options are:

640×350 (16 colors) EGA
320×400 (256 colors) VGA
640×400 (256 colors) SVGA 512K

EGA is for older systems that only support EGA graphics. The default, VGA, should work well with all systems.

The SVGA resolution provides the best graphics but is the slowest. Use this display only if you have a 486 system or higher. You must have 512K on your video card to use this resolution. When you select SVGA, you will be prompted for the type of video card you have. After telling the program which kind of card you have, you are given the option of choosing either your chipset or VESA. Flight Simulator recommends choosing your specific chipset over VESA. If your card is not listed, select the VESA option.

The Mouse and Keyboard

ACTION ***Choose a selection from the keyboard menu that is closest to your own keyboard. If you have a Microsoft-compatible mouse, select a mouse from the menu. Otherwise, select None. When you are happy with your selections, press the Install button.***

Choosing Where to Install the Program

By default, Flight Simulator installs itself on the C drive in a directory called FLTSIM5, but if you want to run it on another drive and directory, you can do so. Simply enter the drive and directory in the dialog box.

WARNING *You could run Version 4 from a floppy disk, but you cannot run Version 5 from one.*

The program will begin decompressing files and installing them on your hard disk. This can take several minutes, depending on how fast your computer is.

Configuring Flight Simulator

When the installation program is finished copying files to the hard drive, you will be asked to configure Flight Simulator. Go through the series of configuration menus, choosing your sound board, default scenery and weather effects, aircraft control device, and so on. Don't worry about having to make permanent decisions. You can change the configuration options whenever you want to. Throughout this book you will be given advice for changing configurations.

Starting Flight Simulator

Do not check the Dynamic Weather Generation At Startup and the Dynamic Scenery At Startup check boxes. These will slow down your system. You may, however, want to select Log Flight Time to start your flight log.

To start Flight Simulator and take your first test flight:

1. Start MS-DOS if you have not done so already.

2. Select the Flight Simulator directory. For example, to change to the directory called FLTSIM5 on the hard disk, type **cd fltsim5** and press Enter.
3. Type **fs** and press Enter.

. . . Quick Test Flight

If you would like to take a test flight before you begin mastering the intricacies of Flight Simulator, you can do so now with the instructions in this part of the step. However, before you take your first test flight, consider using Flight Simulator's crash prevention feature to spare yourself the embarrassment of crashing.

Instant Crash Prevention

What keeps many would-be pilots from flying is the fear of crashing. This is even true of would-be Flight Simulator pilots, who are sometimes afraid of being embarrassed, albeit unharmed, by crashes. Fortunately, you can throw all your crash fears away. To keep from crashing, all you have to do is take these steps before you take off:

1. Select the menu bar.
2. Select Sim. The Sim menu appears, as shown in Figure 1.1.
3. Select Crash Detection.
4. Select Ignore Crash.
5. Select OK.

Now your airplane is super-airplane, impervious to pain. Like a Timex watch, your airplane will take a licking and keep on ticking.

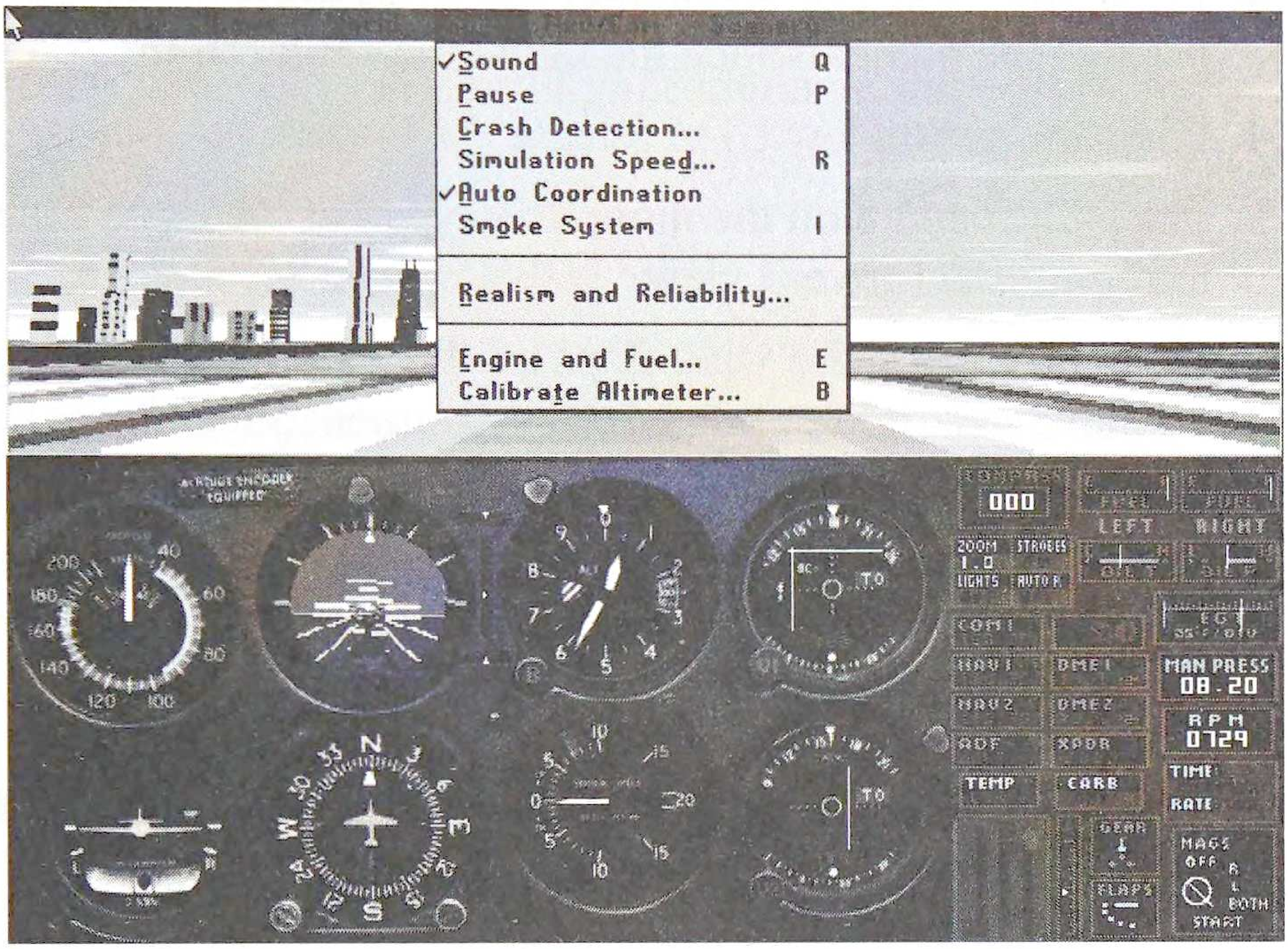

✓Sound Q
Pause P
Crash Detection...
Simulation Speed... R
✓Auto Coordination
Smoke System I
Realism and Reliability...
Engine and Fuel... E
Calibrate Altimeter... B
000
LEFT
RIGHT
ZOOM
1.0
STROBES
LIGHTS
AUTO R
COM1
NAV1
DME1
NAV2
DME2
ADF
XPDR
TEMP
CARB
MAN PRESS
08.20
RPM
0729
TIME
RATE
GEAR
FLAPS
MAGS
OFF
R
L
BOTH
START

FIGURE 1.1: *The Sim menu*

Taking the Test Flight

You'll use your PC keyboard to control the airplane during the test flight.

1. Type *FS* to start Flight Simulator if you have not already done so.

You'll hear a loud noise like an airplane landing, and then you'll find yourself on Meigs Field, a small airport in Chicago. Meigs Field is located on a peninsula on Lake Michigan.

2. Press Shift and 4 on the numeric keypad at the same time. Now you can look out of the left side of the airplane and notice the wing at the top of the three-dimensional display.

3. Press Shift and 2 on the numeric keypad to look out of the back of the plane. Notice the tail at the center of the screen.
4. Press the period key (.) to release the brakes.
5. Press Shift and 8 on the numeric keypad at the same time to return to a forward view.
6. Press F6 to drop the wing flaps a little. The flaps indicator on the lower-right corner of the instrument panel drops one notch.
7. Press and hold down 9 on the numeric keypad to open the throttle. As you do so, watch the throttle position indicator, located on the bottom-right of the instrument panel, slide to its upper limit. Release the 9 key. Keep the plane rolling down the runway while the airspeed increases.
8. At about 70 knots, the plane takes off.
9. About ten seconds after lift-off, press G on the keypad to raise the landing gear.
10. Select the menu bar.
11. Select Options.
12. Select Land Me.

The message "Instructor: My Plane" appears on the screen. This message means that the computer now has control of the airplane. Watch what the computer does with the flaps, throttle, and other controls as it circles the airport and comes in for a landing.

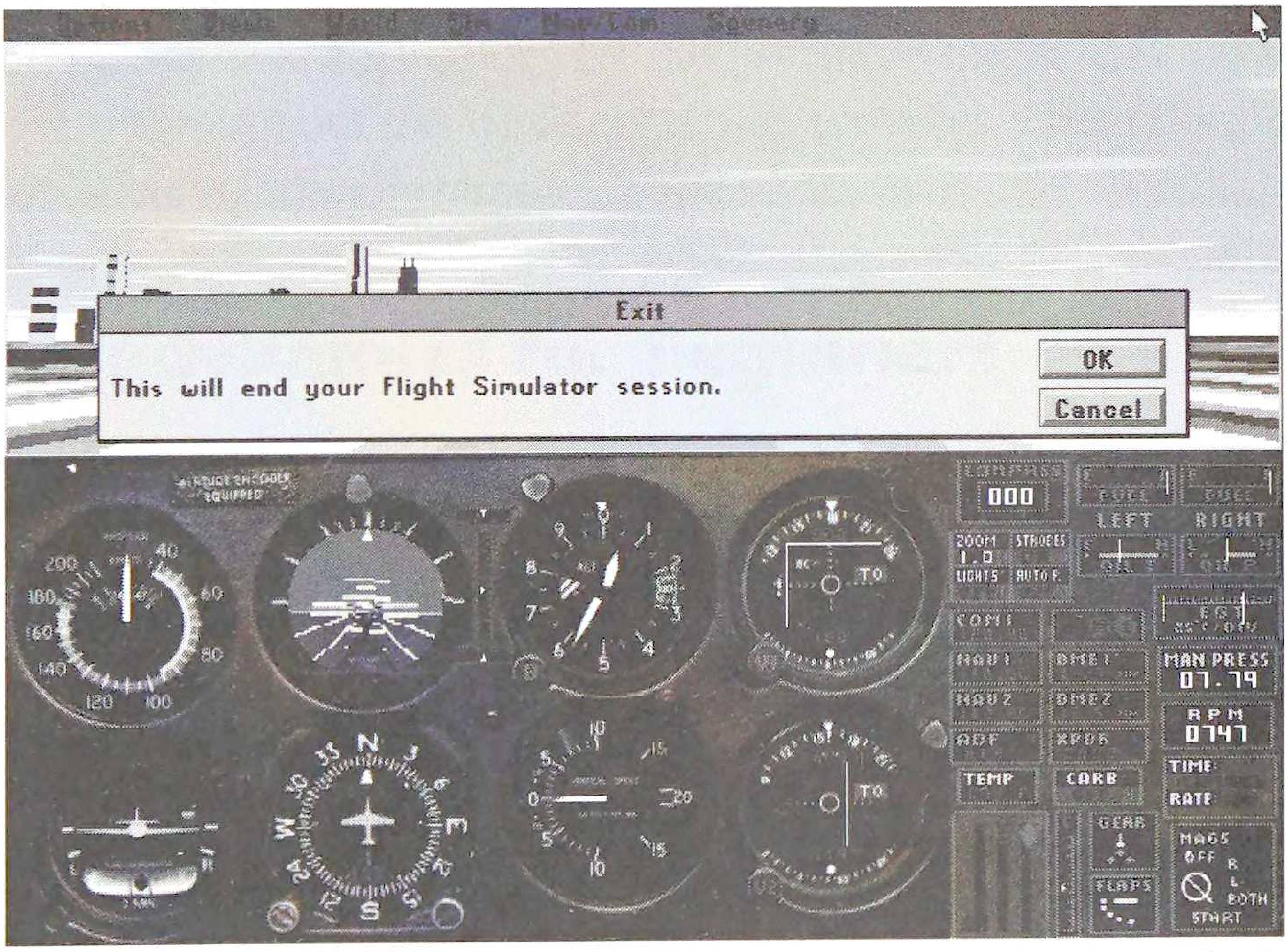
WARNING ***If you have been using Version 4 of Flight Simulator, you may be surprised by the differences between the programs. For example, the new version has a Land Me feature. To change views in the new version you use the Scroll Lock key, not the Shift keys.***

Exiting Flight Simulator

There are three ways to exit Flight Simulator and return to MS-DOS or PC-DOS:

- Press Control+C and select OK
- Press Control+Break
- Open the Options menu, select Exit, and select OK

You'll see the screen in Figure 1.2. Press OK to exit Flight Simulator, or select Cancel if you want to return to the program.


Exit
OK
Cancel
ALTITUDE ENCODER EQUIPPED
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RIGHT
ZOOM
STROBES
LIGHTS
AUTO P.
COM 1
NAV 1
NAV 2
DME 1
DME 2
ADF
XPDR
MAN PRESS
07.79
R P M
0747
TEMP
CARB
TIME
RATE
GEAR
FLAPS
MAGS
OFF
R
L
BOTH
START

This will end your Flight Simulator session.

FIGURE 1.2: *The Exit box*

2

Flight and Navigation Basics

This step briefly explains what every pilot must know in order to fly. Included is a discussion of basic aerodynamics, weather, and navigation. Techniques for navigating in Flight Simulator appear throughout this book. This step provides a brief discussion of navigation terminology and basics.

Aerodynamics for Beginners

Before you climb into an airplane, you need to master a few basic principles, including lift, weight, and drag. This section explains these aspects of aerodynamics. Once you learn them, you can move on to more advanced levels of training.

Lift

Lift, the upward force created by the wings to keep the airplane in the air, is encouraged by the wing's design. Airplane wings are designed so that the top has a greater curve than the relatively flat underside. This way, as the wing passes through the air, air hits the leading edge of the wing and meets again at the trailing edge. Air traveling on top has a greater distance to go, so it travels faster. Lift is the result of the low pressure above the wings and the high pressure area below the wings.

Figure 2.1 shows how lift, along with gravity, drag and thrust, keep an airplane in flight.

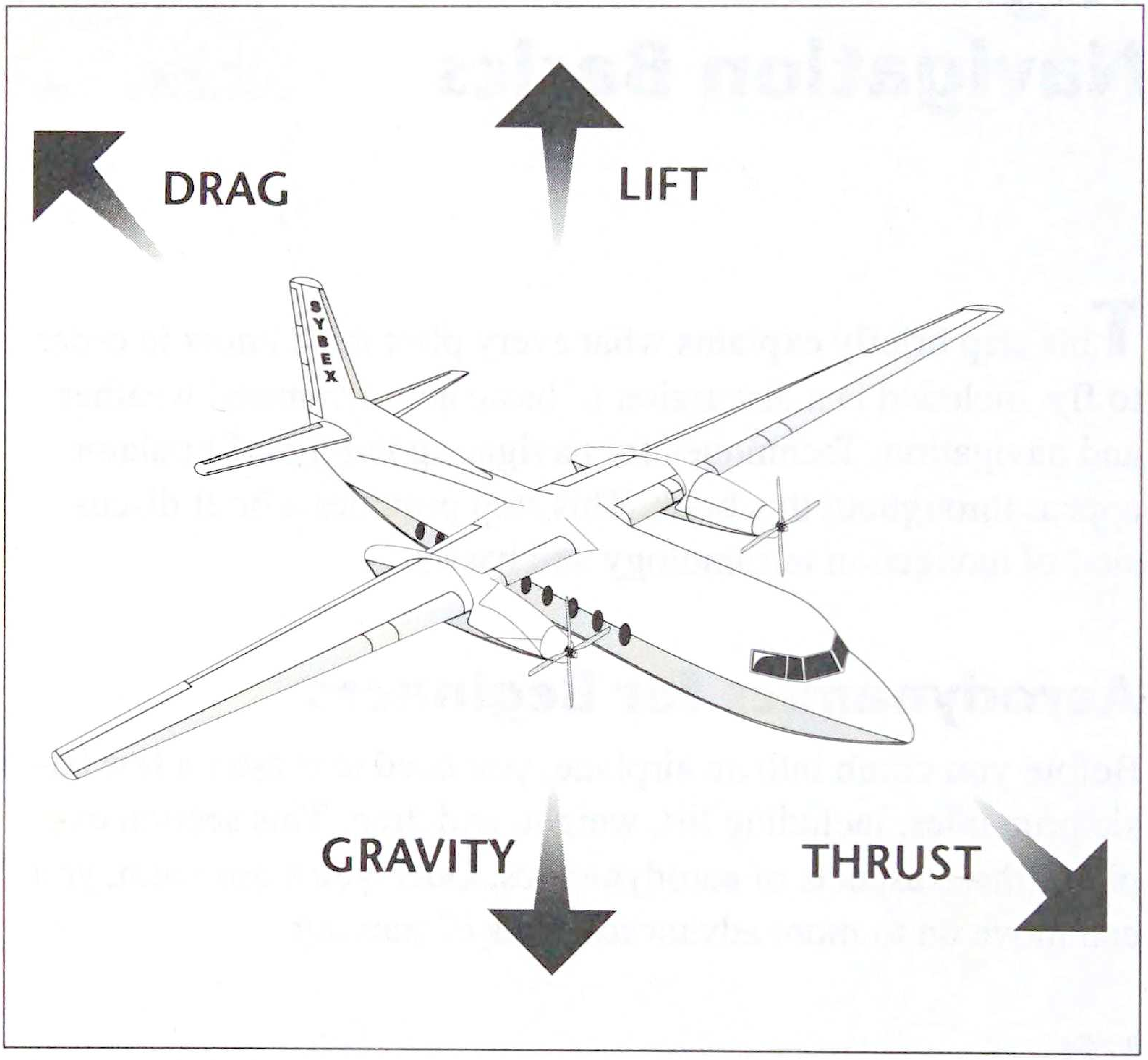


FIGURE 2.1: *Lift, gravity, drag, and thrust enable airplanes to fly.*

When the airplane moves forward, there is an equal and opposite *relative wind.* When the wind is relative, air passes over and under the wings. When enough air is passing over and under the wings, lift occurs.

Lift is influenced by several factors, the first two being the angle of attack and the wing area. The *angle of attack* is the angle between the relative wind and the wing. By changing the angle of attack, you can increase or decrease the amount of lift generated. However, every wing also has a maximum angle of attack, above which the lift capability decreases rapidly.

Lift is not affected solely be weight, but by how much each square-foot of wing area has to be lifted. An airplane's speed also influences lift. The faster you go, the more lift you get. The amount of lift generated is the square of the velocity. Accelerating from 200 to 400 knots quadruples the lift.

Lift is also influenced by air density. At high elevations, airplanes require a longer take off on hot, humid days, because the air at high altitudes is not as dense as the air at low altitudes under dry weather conditions.

Gravity

Gravity is the opposite of lift. An airplane weighs the same on the ground as it does in the air. In order to fly, an airplane needs to counteract downward gravitational pull with a force equal to that gravitational pull. As long as an airplane is producing enough thrust to counteract gravity, it will stay airborne. This is true of gliders, which have no engines but nevertheless stay airborne because they can produce enough thrust.

Thrust

Thrust is the force that moves airplanes forward through the air. In the case of a propeller plane, thrust is created when the propellers take the air and channel it backwards. As a result, a forward-moving force is created—in other words, thrust is created.

In the case of a jet engine, the spinning turbine draws air into the front of the engine, where it is heated. The heated air expands and is then forced through a relatively small opening in the rear of the engine, creating thrust.

Drag

There are two types of *drag:*

- *Parasite drag* is the drag of the plane itself.
- *Induced drag* is the by-product of lift. Induced drag is proportional to airspeed. Increasing speed increases lift, but also increases the induced drag.

Induced drag plus parasite drag equals the total drag that the airplane must overcome to move forward.

Drag does not always have a negative effect on the airplane. Pilots, when they are descending or approaching an airport for landing, sometimes increase the plane's drag in order to slow down. There are two devices for increasing drag: *flaps* and *spoilers.*

- Flaps are located on the trailing edge of the wing, close to the fuselage. When the flaps are dropped, drag is increased, as is lift. The increased lift is helpful because it enables the pilot to reduce engine power (thrust) while keeping the plane from falling. Flaps are used primarily for take offs and landings.
- Spoilers, also called *air brakes,* are located on the fuselage, usually behind the wings. Spoilers are used in take offs to allow the plane to become airborne at a slower speed, and in so doing use less of the runway.

• • • A Look at the Weather

Pilots need to have a thorough understanding of weather. Indeed, many of the questions asked on pilot examinations have to do with weather. In the real world, you can't fly an airplane unless you know weather basics and how weather affects airplanes in flight.

Weather study is also an ongoing part of a pilot's duties. Pilots study weather charts before departure. They know when they are going to encounter fronts. During the flight, pilots look for clues of impending choppy air, including rapid changes in the outside air temperature, changes in wind speed and/or direction, and changes in barometric pressure.

Clouds

Water vapor is always present in the air. When air is cooled, the water vapor is squeezed out and becomes visible as a cloud. On the other hand, when the weather is dry and the humidity is low, there isn't as much moisture in the air, and there is less potential for clouds. Meteorologists are able to measure the moisture content of the air and determine exactly at what temperature the air will become saturated with water vapor and clouds will form. That temperature, called the *dewpoint,* is lower on dry days and higher on more humid days.

Because clouds restrict visibility, predicting when a clear day will grow cloudy is an essential part of aviation weather forecasting. If the surface temperature is 50 degrees and the dewpoint is measured at 49, fog will develop if the air is cooled further. However, the fog will dissipate when the sun reheats the air and the temperature moves up again.

The two most common types of clouds are *cumulus* and *stratus* clouds:

- Cumulus clouds are large, fluffy puffballs. Because *convective air* (air streams of different temperatures flowing together) is what forms cumulus clouds, you will encounter turbulence when you fly in or near cumulus clouds.
- Stratus clouds are flat, layered clouds. Usually you can fly through them without experiencing any turbulence.

Two other kinds of clouds are *altocumulus* and *altostratus* clouds. *Alto* means "height," and altoclouds are found at altitudes above 25,000 feet. Some cloud names have *nimbus* as a suffix. In meteorological terms, *nimbus* refers to a cloud from which rain or snow is falling. An altonimbus cloud is a high-altitude cumulus cloud carrying rain or snow.

Many airplanes carry weather radar. Weather radar signals are emitted from a 30-inch plate in the nose of the aircraft. This plate detects moisture in the air. Newer radars are capable of detecting weather to distances of 320 miles in front of the flight path. Weather radar is more accurate at higher altitudes. Closer to the ground, lakes, rivers, oceans, and even skyscrapers can clutter the scope and keep the radar from detecting weather accurately.

Turbulence

Turbulence results from an airplane flying through irregular atmospheric phenomena, such as dramatic changes in air pressure. Turbulence comes under three ratings: light, moderate, and severe. Severe turbulence is rare. Light turbulence causes pilots and passengers to feel a slight strain against their seat belts. In moderate turbulence, the strain is more noticeable. Interestingly, when most people encounter moderate turbulence, they feel as if they are falling.

You can experience turbulence even when there literally isn't a cloud in the sky. So-called CAT (clear-air turbulence) takes place when there are dramatic changes in wind direction and air pressure. Turbulence is also caused by convective air. Choppy air is encountered when a plane is 3000 to 4000 feet above ground. It results from the earth's rotation, which creates friction between the ground and the atmosphere and results in changing winds. Mountains and buildings near airports can also alter wind conditions, causing choppy air. Turbulence is also caused by clouds, air masses, and fronts—the type of weather discussed every evening on the news. Whenever you cross a weather front, you will encounter changes in temperature and wind direction. At such times, you must be ready to encounter turbulence as well.

Thunderstorms

Thunderstorms produce turbulence and other annoyances, including lightning and hail. When thunderstorms occur over airports, pilots have to hold a safe distance above the airport until the thunderclouds pass. Thunderstorms are easy to avoid when you are cruising. When you are flying above 20,000 feet, the rule is to fly no closer than 20 miles to a thunderstorm to avoid moderate and possibly severe turbulence. Pilots often fly on the upwind side of the direction of the storm's movement. The upwind side provides the smoothest ride and least risk of hail.

Navigation

Part of flying is learning how to get where you want to go. The art and science of navigation depends on calculations, map reading, being able to read flight instruments, and just plain "keeping your eyes open."

Pilotage

Pilotage is the art of cross-country flying from one visible landmark to another, using only a flight chart for guidance. Pilotage is the simplest form of navigation, where the pilot simply watches for landmarks. Pilotage is impractical, however, because of an inevitable lack of available landmarks, or lack of airspace between them, and conditions of low visibility. You also have to fly low enough to see what you are doing.

Figure 2.2 shows a view from the cockpit. With pilotage, you would have to fly your plane across a landscape like this one and know it well enough to tell where you are going.

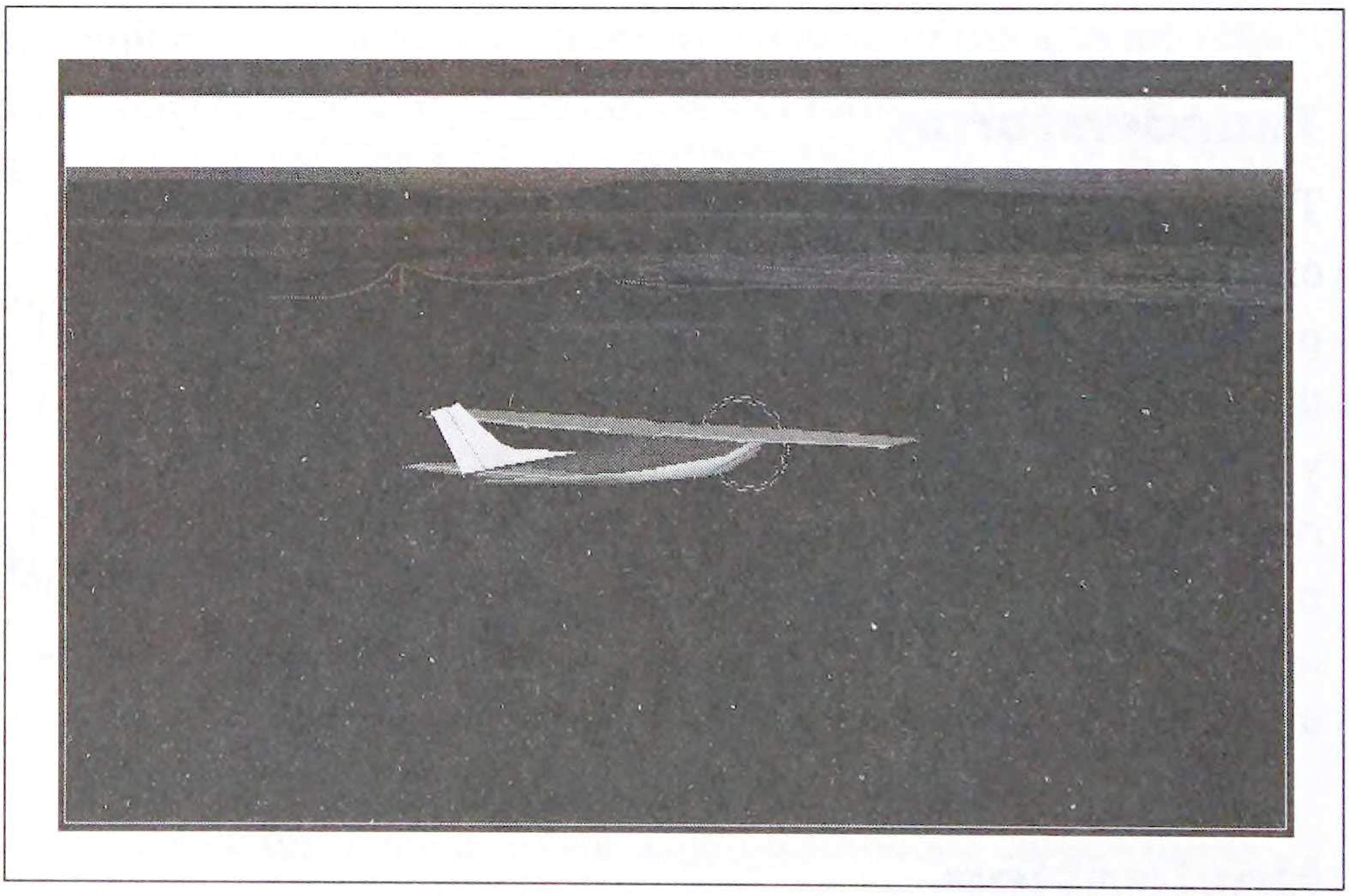


FIGURE 2.2: ***Pilotage means navigating with the use of landmarks only. This figure illustrates how difficult pilotage can be.***

Dead Reckoning

Dead reckoning is number-crunching navigation. Dead reckoning navigation uses computations based on airspeed, course, heading, wind direction, wind speed, ground speed, and elapsed time. Factoring in wind speed, you point your plane in the direction of your destination and fly at a known speed for the amount of time it takes to cover the distance.

If you make a mistake with dead reckoning techniques, you could end up miles from your target destination. That is why dead reckoning is rarely used alone. On the other hand, combining dead reckoning with pilotage allows pilots to make calculation adjustments for errors using landmarks. Dead reckoning lets pilots fly over course stretches where there are no landmarks.

VORs

VOR stands for *very high frequency omnidirectional radio signal.* A VOR is an omnidirectional identification signal followed by a circular sweeping directional signal, both at very high frequencies. The NAV radio in your Flight Simulator airplane decodes these signals to determine the angle or radial from the station.

DME (Distance Measuring Equipment)

Your airplane has *distance measuring equipment* (DME) that registers nautical miles from the VOR to which you are tuned. Figure 2.3 shows a DME reading as it looks on the control panel of Flight Simulator.

WARNING ***Sometimes the DME is blank even though you have a valid VOR tuned in and working. That is because the DME system does not have the range that the VOR directional navigation signal has.***

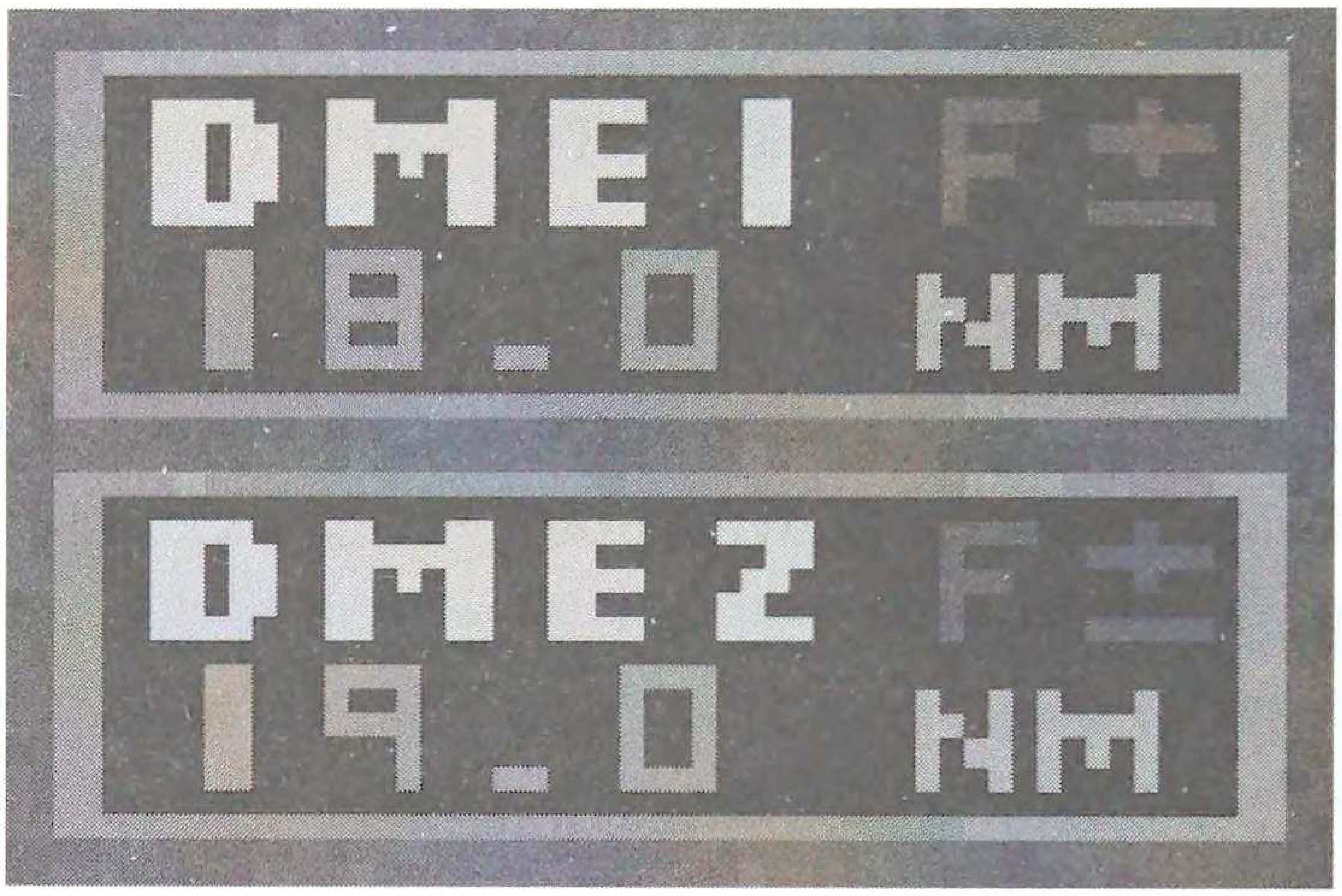


FIGURE 2.3: *A DME reading*

ILS

The *instrument landing system* (ILS) is the primary landing instrument system. The direction, however, is set automatically and the needle on the instrument that reads such signals in your airplane is much more sensitive than the needles linked to VOR.

NDBs

Nondirectional radio beacons (NDBs) are navigation aids. Your airplane has a built-in ADF (automatic direction finder) to locate them.

EFIS/CFPD Display

One of the most futuristic aspects of Flight Simulator is the EFIS/CFPD, or Electronic Flight Instrument Systems/Command Flight Path System Display. EFIS includes checklists on VDT displays and engine controls. CFPD is a navigation tool that creates a "highway in the sky," or path for you to follow. Figure 2.4 shows the "rectangle" path. These paths are designed for beginning pilots to help them navigate and be sure they are doing so correctly.

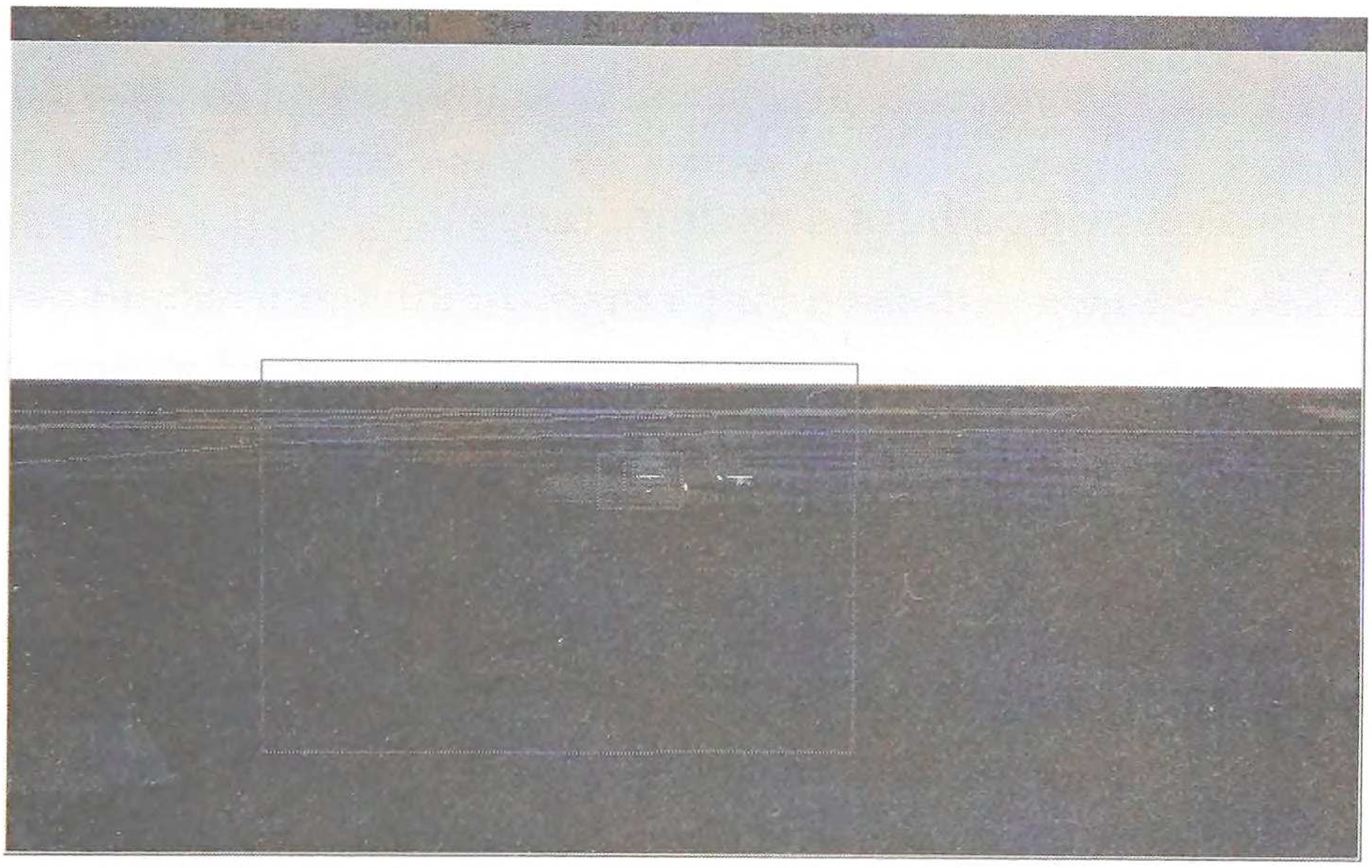


FIGURE 2.4: *An EFIS path. This one is the path made of rectangles.*

To select the EFIS/CFPD:

1. Select the menu bar.
2. Select Nav/Com.
3. Select the EFIS\CFPD Display. A dialog box appears.
4. Select the EFIS Master Switch.

5. Make Appropriate choices. You can choose among the following navigational aids:
    - Lock to your ILS for a Landing Approach.
    - Lock to VOR 1.
    - Lock to VOR 2.
    - Use a path made of rectangles.
    - Use a path made of telephone poles.
    - Use a path resembling a yellow brick road.
    - Follow a thick path.
    - Follow a thin path.
    - Follow a medium path.
    - Follow a path for a short range.
    - Follow a path for a medium range.
    - Follow a path for a long range.
6. Select OK.

3

Reading and Using the Flight Instruments

You need to know your way around the instrument panel of your airplane before you try any long flights. The major instruments tell you the speed, direction, and elevation of your airplane. Flight Simulator also provides several communications instruments for navigation. Finally, there are safety and maintenance instruments. These instruments are used in conjunction with the airplane's control system.

This step tells you how to identify and use the Flight Simulator instruments. It tells you how to read the instruments, how to use them in flight, and how to turn them on and off.

TIP ***If you are using 640×400 resolution, you don't need to use the Preference dialog box to make your instruments more readable. It isn't necessary.***

Probably the first thing you will want to do is make your instruments more readable. You can do this with the Preference dialog box. To enhance the readability of your instruments:

1. Select the menu bar.

2. Select Options.
3. Select Preferences.
4. Select Instrument. A dialog box appears.
5. Select the Panel Display list box.
6. Select Enhanced Readability.
7. Select OK.

Altitude, Speed, and Direction Instruments

How high do you want to go? How fast do you want to go? What direction do you want to go? The instrument panel gives you readings about altitude, speed, and direction. The instrument panel is shown in Figure 3.1.

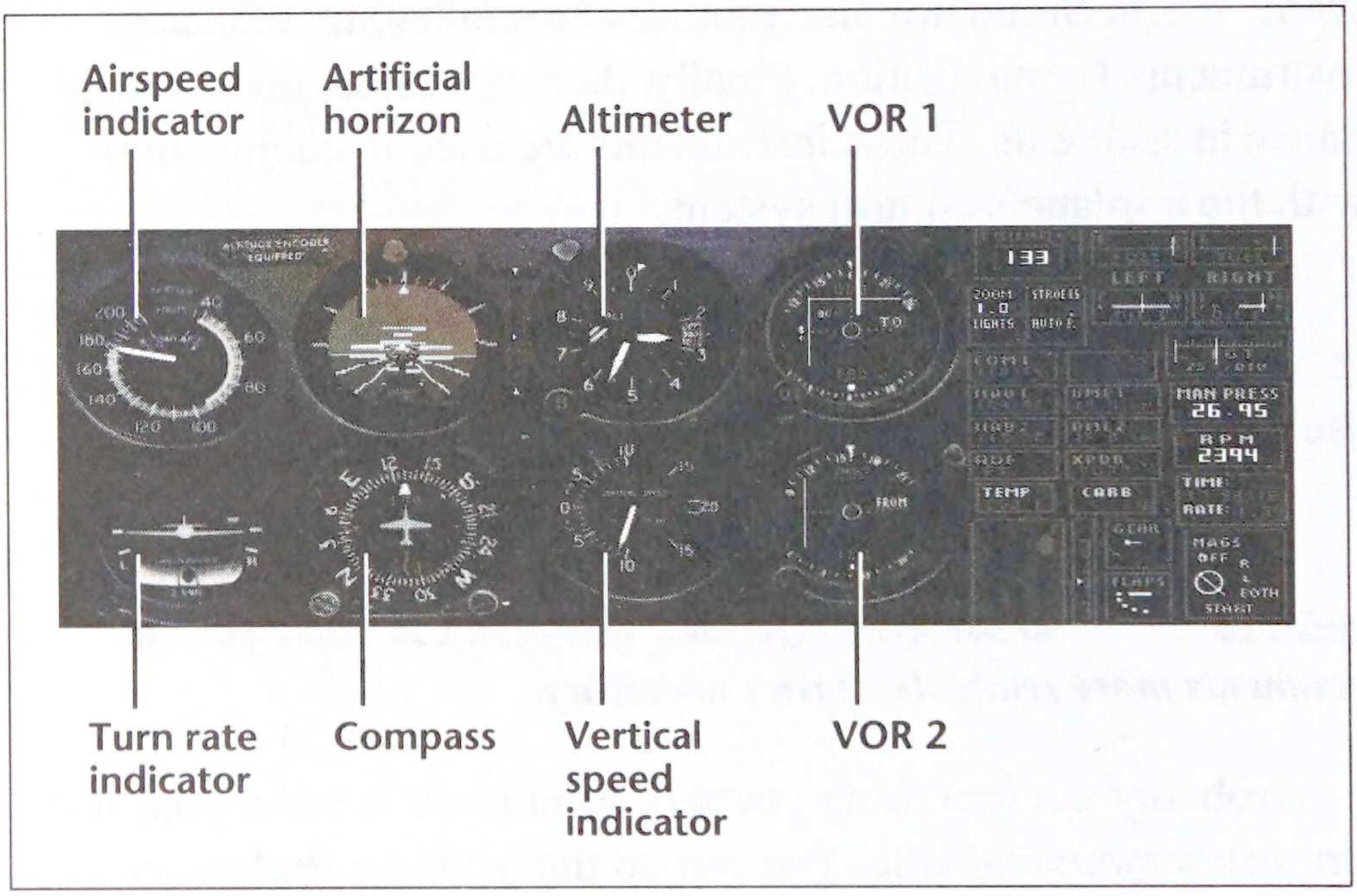

Airspeed indicator
Artificial horizon
Altimeter
VOR 1
Turn rate indicator
Compass
Vertical speed indicator
VOR 2
133
LEFT
RIGHT
MAN PRESS
26.95
RPM
2394
TEMP
CARB
GEAR
FLAPS
START

FIGURE 3.1: *The instrument panel*

TIP ***Instrument panels look slightly different, depending on the type of plane you are flying. In this step, the figures show the Cessna panel. Cessna is the default airplane in Flight Simulator.***

Airspeed Indicator

As is the case with ships, airplane travel speed is measured in *knots.* A knot equals one nautical mile. The *airspeed indicator* is the instrument that tells you the airspeed in knots. The airspeed indicator is shown in Figure 3.2.

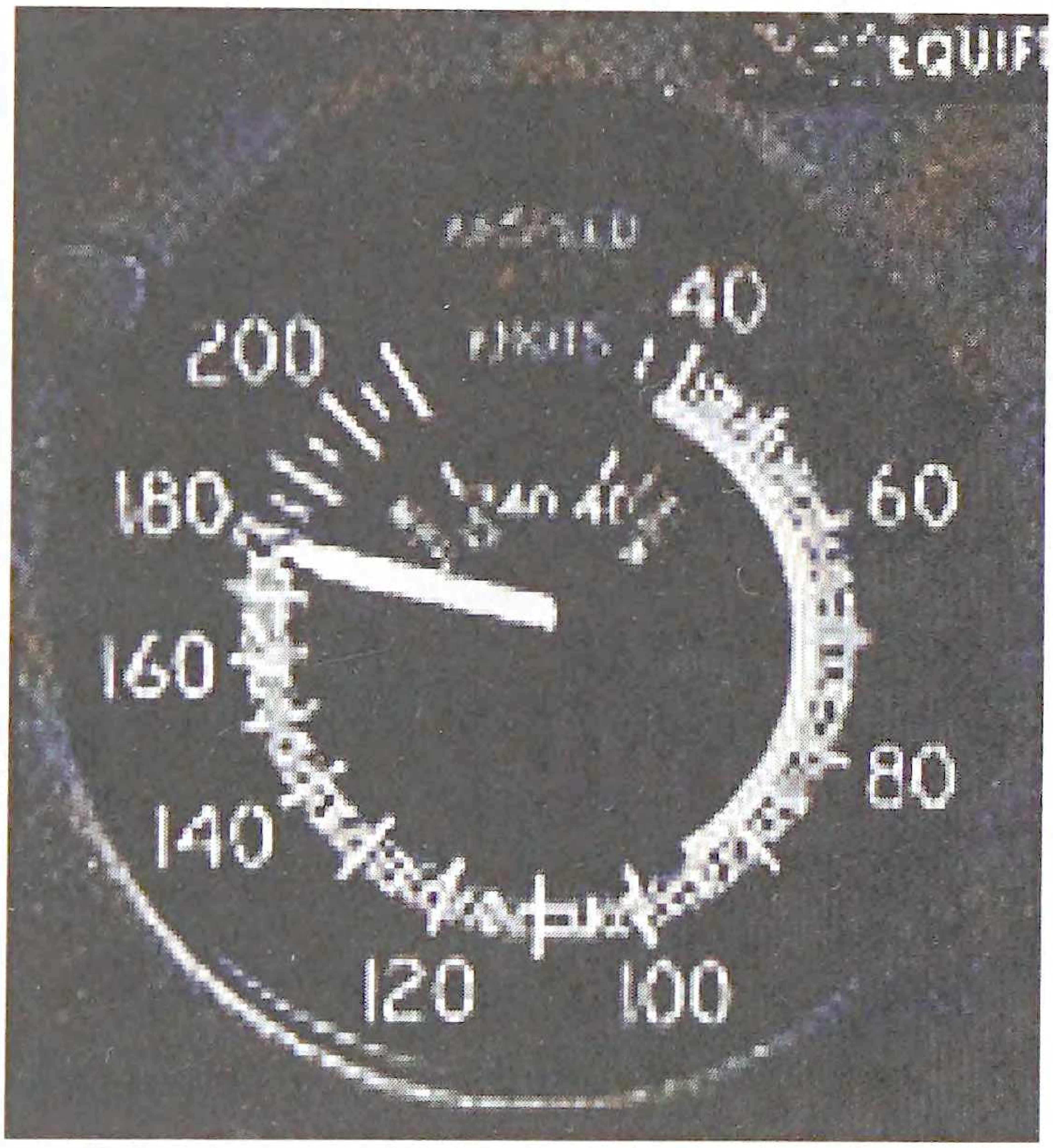


FIGURE 3.2: *The airspeed indicator*

TIP ***To compare knot speed to statute miles per hour, multiply the knot speed by 1.507. To see how statute miles per hour compares to knot speed, multiply the miles-per-hour figure by .869.***

To get speed measurements, the airspeed indicator measures the difference between the oncoming airspeed as measured by the pilot tube and the departing airspeed as measured by the static vent. The pilot tube faces the oncoming air, but the static vent is mounted on the back side of the airplane. The airspeed indicator measures the difference between the air in the pilot tube and the vent. When the airplane is parked on the ground, the difference between the pressure readings in the static vent and the pilot tube is 0, so the airspeed is 0. However, when the airplane is in flight, there will obviously be a difference. This difference will show up as airspeed.

Adjustments, however, have to be made before you can calculate true airspeed. For the purposes of Flight Simulator, the calculated speed is multiplied by 1 plus 1.5 percent for every 1000 feet of sea-level altitude. For example, if you are flying at 8000 feet above sea level with an indicated airspeed of 100 knots, your true airspeed is approximately 112.0 knots, or $100 \times (1 + 8(.015))$.

True airspeed, however, should never be confused with *ground speed,* the speed at which an airplane moves on the ground. That speed will take into account headwinds and tailwinds. Headwinds must be subtracted from the true airspeed. Tailwinds, on the other hand, must be added.

Altimeter

The altimeter, shown in Figure 3.3, measures altitude in feet above *mean sea level* (MSL). The altimeter, which is an air-press-activated gauge, is read like a clock. However, an altimeter has ten divisions while a clock has twelve. The large hand tells you how many *hundreds* of feet the plane is above sea level, set in 20-foot increments. The small hand tells you how many *thousands* of feet the plane is above sea level. The small arrow near the outside of the gauge indicates *tens of thousands* of feet above sea level.

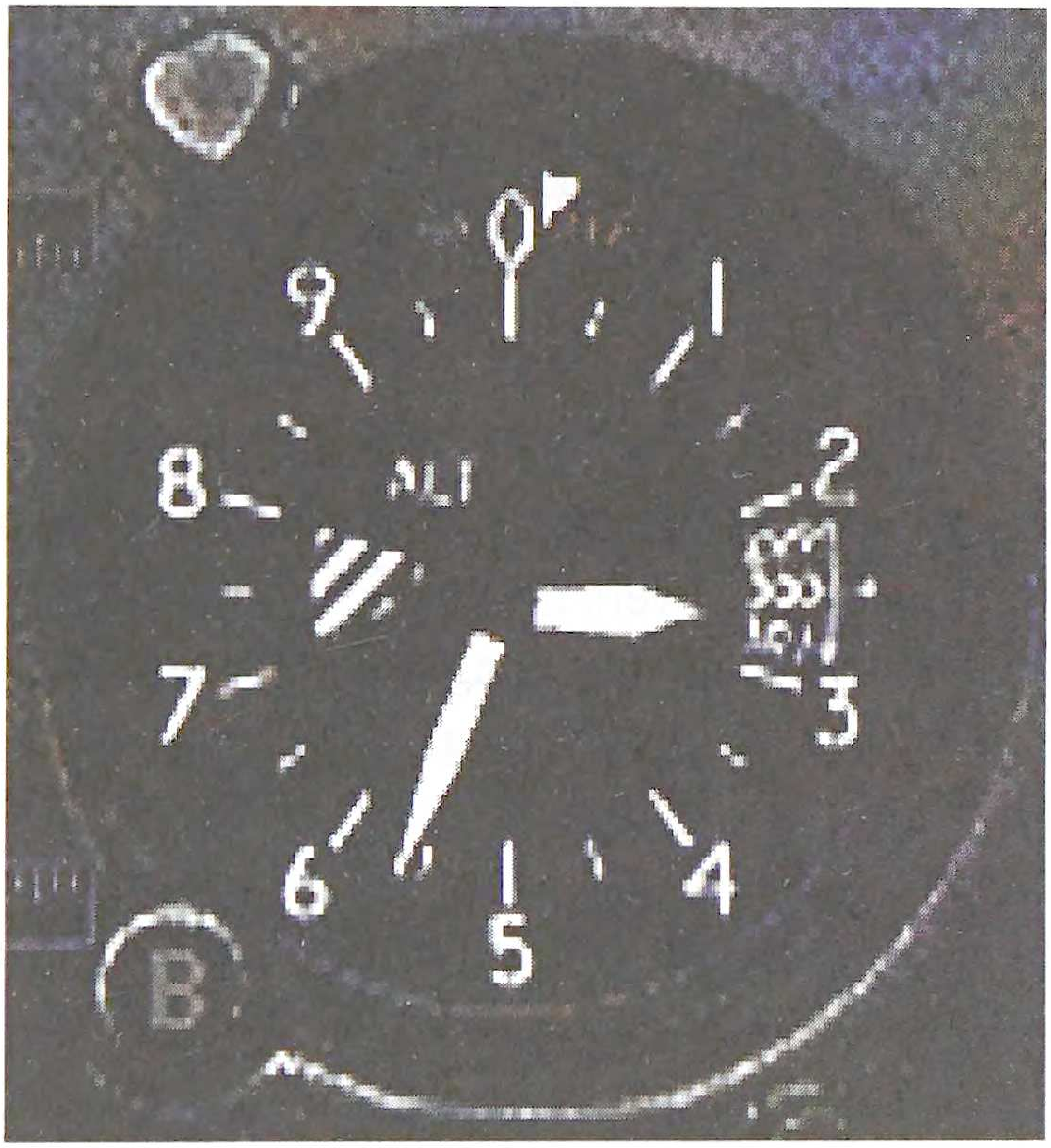


FIGURE 3.3: *The altimeter*

TIP ***Sea level is not necessarily the same as ground level. For example, at an airport on top of a 7500-foot mountain, the altimeter registers 7500 feet even though the plane is sitting on the ground. When you are flying at altitudes above 17,999 feet, you need to calibrate the altimeter to standard pressure, which is set at 29.92 inches of mercury (in Europe it is set to 1013 millibars).***

Because the altimeter is sensitive to changes in barometric pressure, Flight Simulator allows you to make adjustments to the altimeter. To calibrate an altimeter:

1. Select the menu bar.
2. Select Sim.
3. Select Calibrate Altimeter.
4. Type in the barometric pressure in millibars or Hgs.
5. Select OK.

Vertical Speed Indicator

Is your airplane going up or down? The vertical speed indicator, shown in Figure 3.4, answers this question and tells you the speed at which the airplane is flying at a constant altitude. The bottom of the instrument, which is graduated in hundreds of feet per minute, shows descents; the top shows climbs. This gauge operates on air pressure changes and is influenced by absolute barometric pressure. It lags slightly behind the responses of the aircraft.

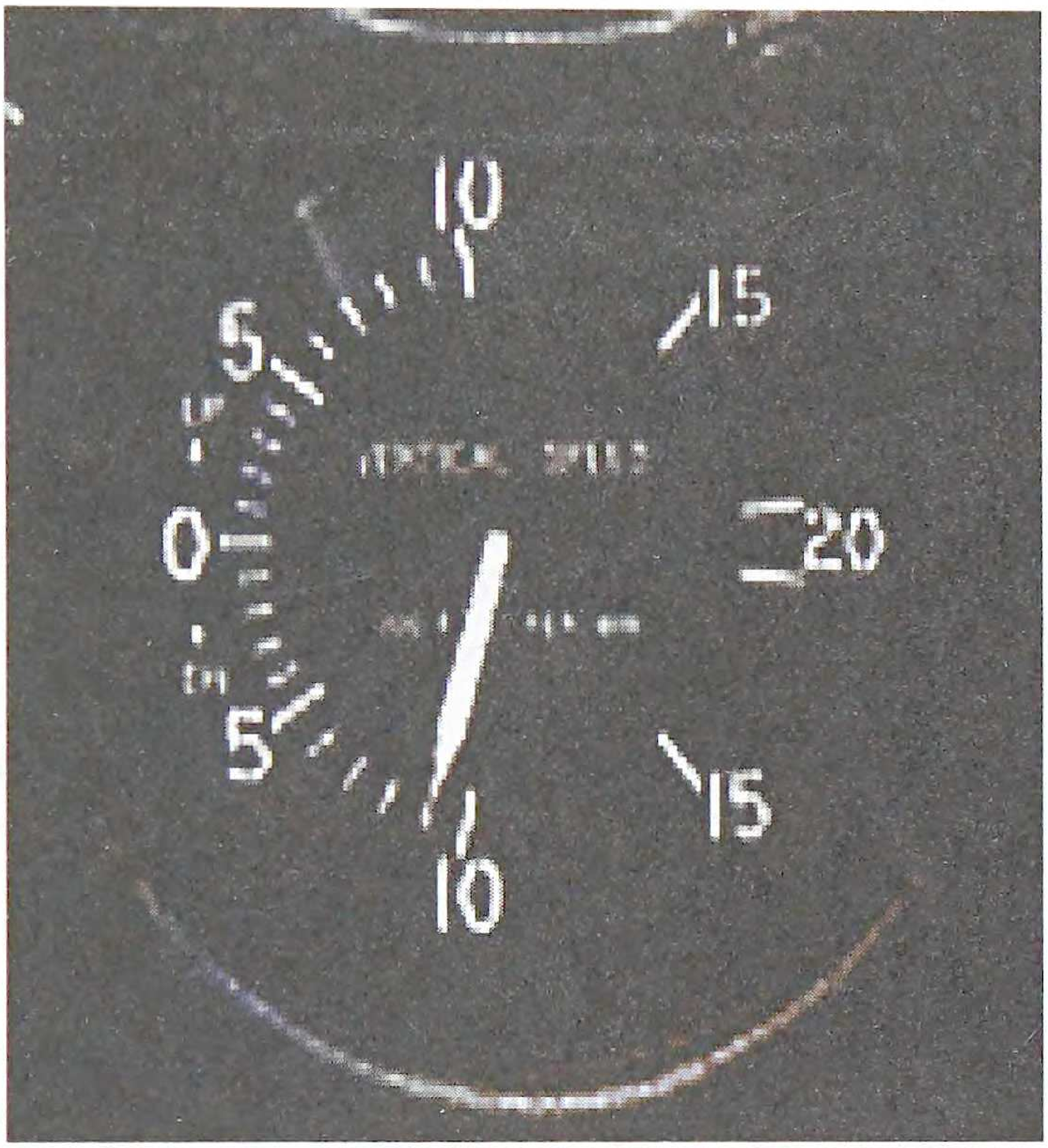


FIGURE 3.4: *The vertical speed indicator*

Gyroscopic Instruments

Gyroscopic instruments use a gyroscope to maintain an airplane's orientation along one or more of its axes. An airplane has three typical gyroscopic instruments:

- The artificial horizon
- The turn coordinator
- The heading indicator

The gyroscopic instruments are shown in Figure 3.5.

The *artificial horizon* tells you the position of the airplane relative to the earth's surface. This instrument displays both

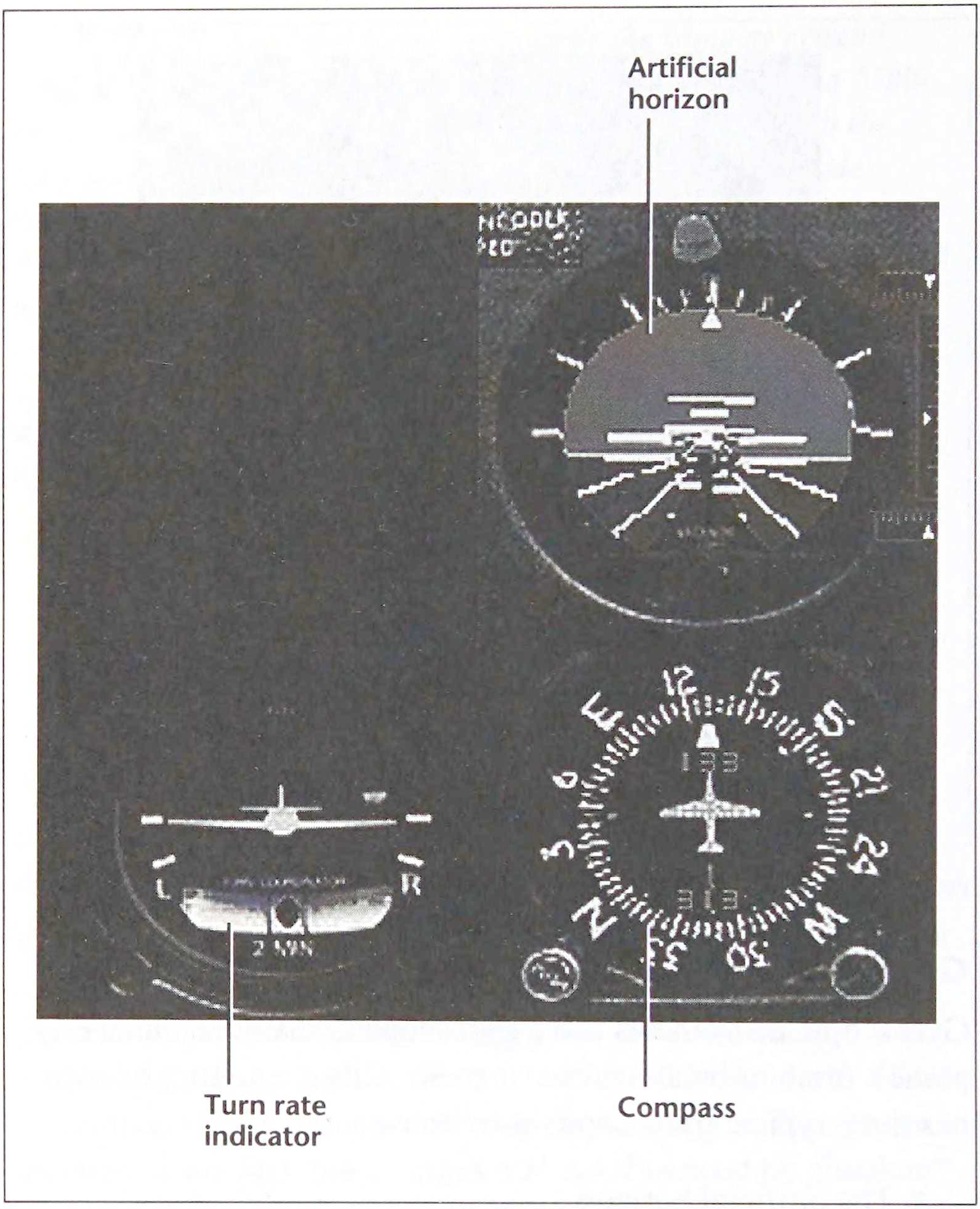

Artificial horizon
Turn rate indicator
Compass

FIGURE 3.5: *The gyroscopic instruments*

pitch, whether the airplane's nose is up or down, and *bank,* the angle the wing forms with the horizon.

When the center bar of the artificial horizon is aligned with the horizon, you are flying in a straight and level path. Bank marks, on the other hand, rotate around the edge of the attitude indicator.

The *turn coordinator* is actually a combination of two instruments, an airplane replica and an inclinometer. The airplane replica in the middle of the instrument moves by rolling proportionally with the roll rate of the airplane. The inclinometer shows whether the rudder and aileron are working together correctly.

- If the ball in the liquid-filled glass tube moves outside of the center of the tube, the rudder and ailerons are not coordinated.
- If the ball moves to the outside of the turn, the airplane is skidding.
- If the ball moves to the inside of the turn, the airplane is slipping.

Fortunately, Flight simulator lets you use auto-coordination so that the ailerons and the rudder are aligned automatically. However, more adventurous pilots can make adjustments by applying sufficient rudder pressure.

Although the turn indicator measures turn rate and coordination, no numerical value appears on it. Instead, a single turn rate position is marked by the turn indicator (the small airplane symbol on the gauge).

When the gauge aligns with the L (Left) or R (Right) indicator, you will make a complete 360 degree turn in two minute turns. (The turn coordinator is also useful for timed turns.) This instrument uses a canted gyroscope reflecting both heading and bank changes. Pitch, however, has no effect on the gauge.

The turn coordinator also has an indicator for aircraft coordination or slip/skip attitude. When the ball is centered, the aircraft's longitudinal axis is coordinated. In general, you want to make coordinated turns because they are the safest.

The normal magnetic compass with which most people are familiar gives a wrong reading any time an airplane is pitched, accelerated, decelerated, or banked. In fact, a magnetic compass only gives the correct reading when an airplane is flying straight in an unaccelerated flight. The *heading indicator,* by using a gyroscope, makes the magnetic compass useful in navigation.

You need to make sure that the magnetic compass has stabilized after a turn or climb-to-level movement. Otherwise, you could end up with a wrong heading.

TIP ***The heading indicator needs to be reset to a magnetic compass every ten to fifteen minutes to correct errors caused by bearing friction. The airplane should be straight and level, however, and in an unaccelerated flight before the heading indicator is reset.***

Navigation Tools and Radios

Most of the navigation tools found in an airplane are related to radios, because most navigation today is guided by radio signals. On the other hand, airplanes do have magnetic compasses just like the ones Boy Scouts and Girl Scouts use. Magnetic compasses are used in conjunction with the other more sophisticated tools.

Following is an explanation of the navigation tools. You will refer to this step often as you use Flight Simulator. Figure 3.6 shows where the navigation tools are located.

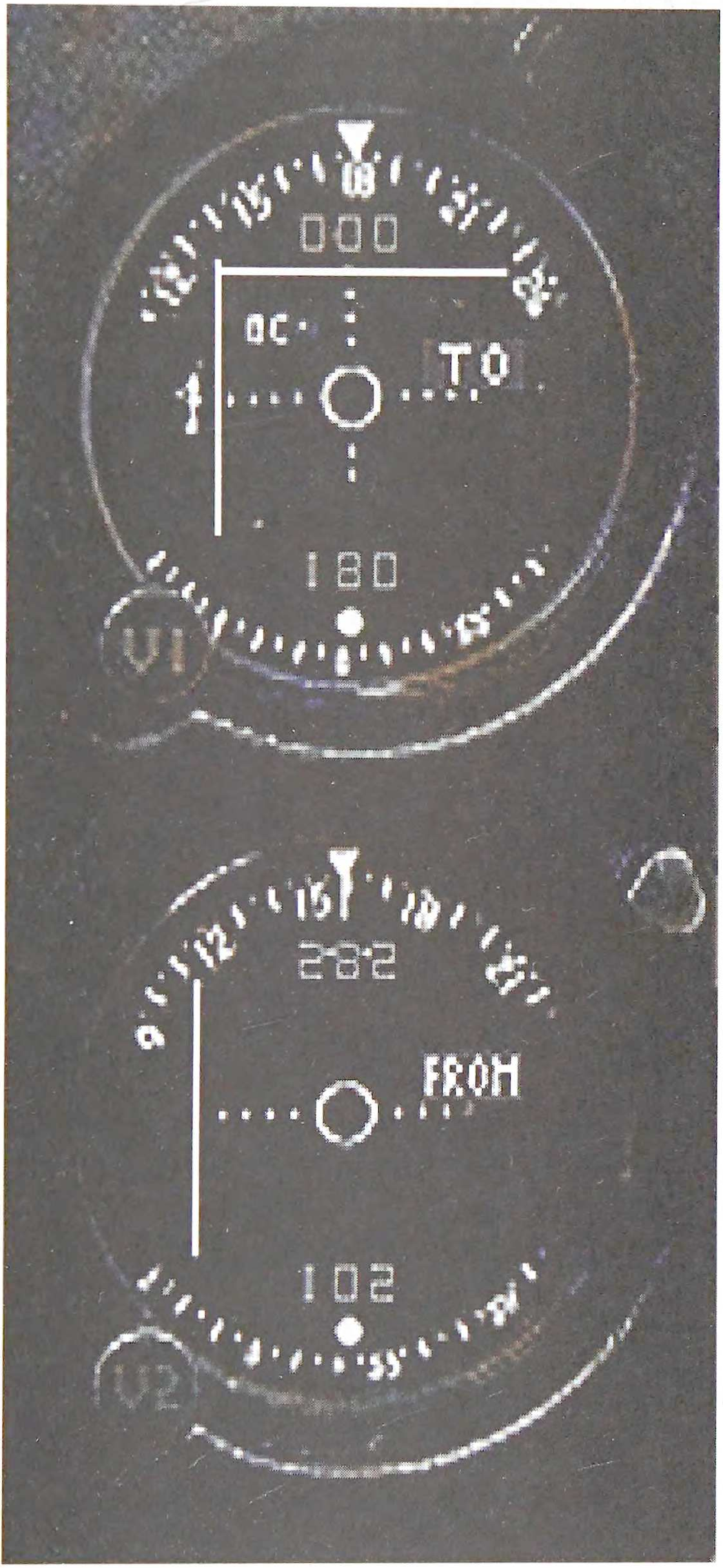

000
TO
180
V1
282
FROM
102
V2

FIGURE 3.6: *The navigation tools*

OBI with Glidescope

The OBI, or *omni-bearing indicator,* is used in conjunction with the Navy radio to tune into VORs (very high frequency omnidirectional radio) beacons. The OBI reading is independent of the airplane's heading. It does, however, tell you your aircraft's position relative to the VOR station radial.

You can use the *course selector*—the vertical line running through the OBI—to estimate the heading, or direction, you must fly on to remain aligned with the radial. The *radial* is the direction beam radiating from a VOR. The OBI indicator will tell you the valid course deviations in either flight direction. As you can see, the indicator is marked with the letters *TO.*

If you need to know the location of the VOR you are tuned into, follow these steps:

1. Select the menu bar.
2. Select Nav/Com.
3. Select Navigation Radios.

A dialog box will appear. It will tell you your heading, the VOR frequency, its location, and its identification.

TIP ***On windy days, you may have to compensate for crosswinds strong enough to blow you off your radial by decreasing or increasing the heading.***

For ILS (Instrument Landing System) radio receiver approaches, the OBI uses the course selector to track the *glide beam.* It also uses a horizontal needle to track the *localizer,* also known as an *azimuth beam.* The intersection of these beams gives you the proper landing course when you bring down an airplane.

The omni-bearing indicator, which does not have a glidescope indicator, uses the NAV2 radio to tune into very high frequency omnidirectional radio beacons.

NAV1 Radio

The NAV1 radio receives ILS (instrument landing system) frequencies and tunes in and identifies VOR navigation aids. The NAV radios receive 200 channels at frequencies between 108.00 and 117.95 MHz, with 50 kHz separations on a sweeping directional signal. The NAV receiver in your aircraft decodes VOR signals to determine the angle or radial you are on. The NAV receiver also controls the omni-bearing indicator that can guide your plane along a radial as you move toward or away from a VOR station.

NAV2 Radio

The NAV2 radio works basically the same way as the NAV1 radio. However, instead of one, you use two VOR stations simultaneously to cross-check your position.

TIP ***You can use both OBIs and NAV radios simultaneously to help you find direction. To identify your exact position, tune in two VORs and find the radial you are currently intercepting for each VOR. The point of intersection for the two radials represents your position.***

Distance Measuring Equipment (DME)

Distance measuring equipment (DME) works with the NAV 1 and NAV 2 radios to tell you how many nautical miles you are from a tuned-in VOR.

Automatic Direction Finder (ADF)

The automatic direction finder (ADF), shown in Figure 3.7, is the navigation instrument used with nondirectional radio beacons (NDBS) or commercial AM radio stations to discern relative bearing. Magnetic bearing to the NDB is then calculated by adding the relative bearing to the aircraft's magnetic heading.

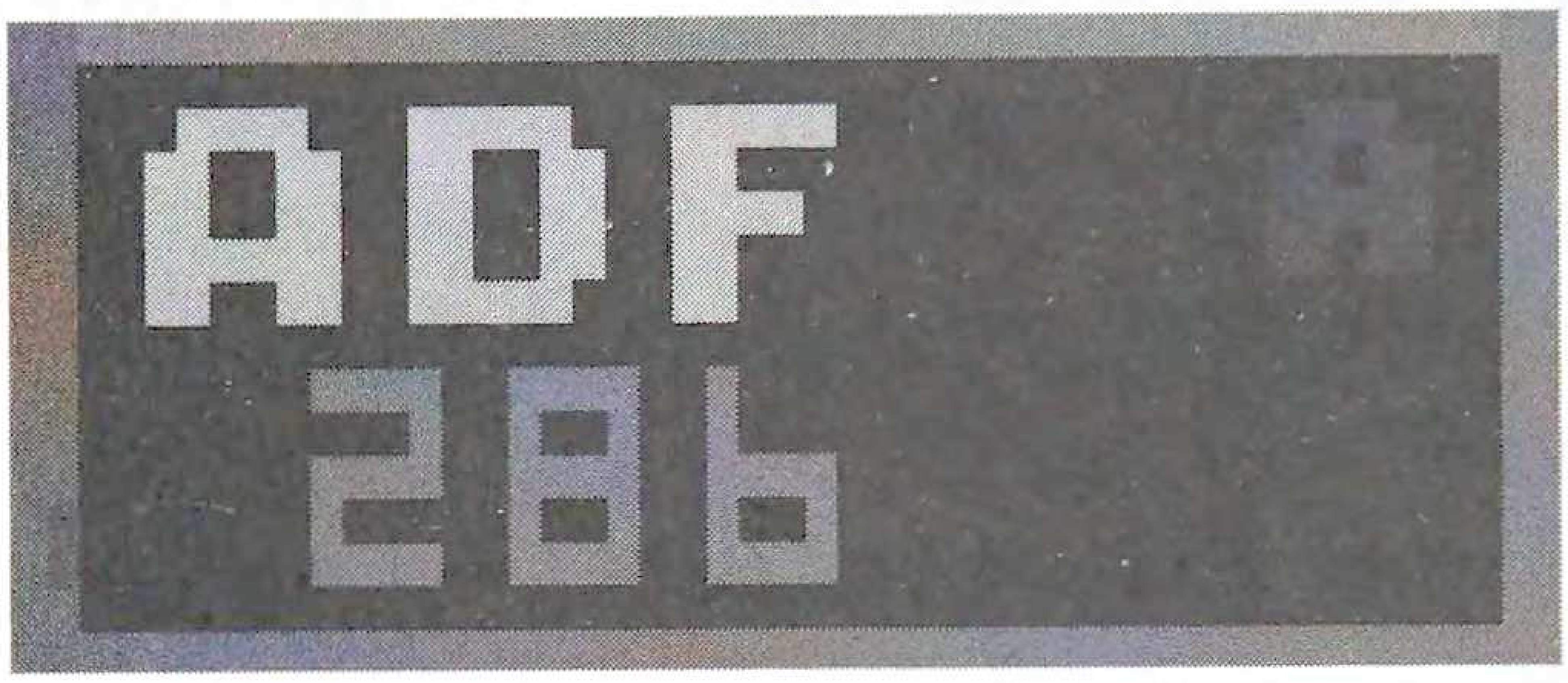


FIGURE 3.7: *The automatic direction finder*

You can change ADF frequencies. To do so:

1. Select the menu bar.
2. Select Nav/Com.
3. Select ADF. A dialog box appears.
4. Type in the ADF Frequency.

COM Radio

The *COM radio is* a transceiver that receives and transmits 360 channels at frequencies between 118.00 and 135.95 MHz, with 50 kHz separations.

Fight Simulator Version 5 allows you to communicate with your radios. To receive the latest message sent to you:

1. Select the menu bar.
2. Select Nav/Com.
3. Select Communications.
4. Select Listen To Latest Message.

Transponder

The *transponder* is the radio used for identifying your aircraft on ATC (Air Traffic Control) radar. To set the transponder frequency:

1. Select the menu bar.
2. Select Nav/Com.
3. Select Transponder. A dialog box appears.
4. Type in the appropriate frequency and select OK.

O, M, and I Lights

The outer (O), middle (M), and inner (I) marker lights indicate when your airplane is over the outer, middle, or inner marker beacons when you use the Instrument Landing System (ILS) during an instrument approach.

• • • Safety and Maintenance Instruments

The safety and maintenance instruments include the clock, warning signals, and several indicators. How to read these instruments is explained in this part of the step. The safety and maintenance instruments are shown in Figure 3.8.

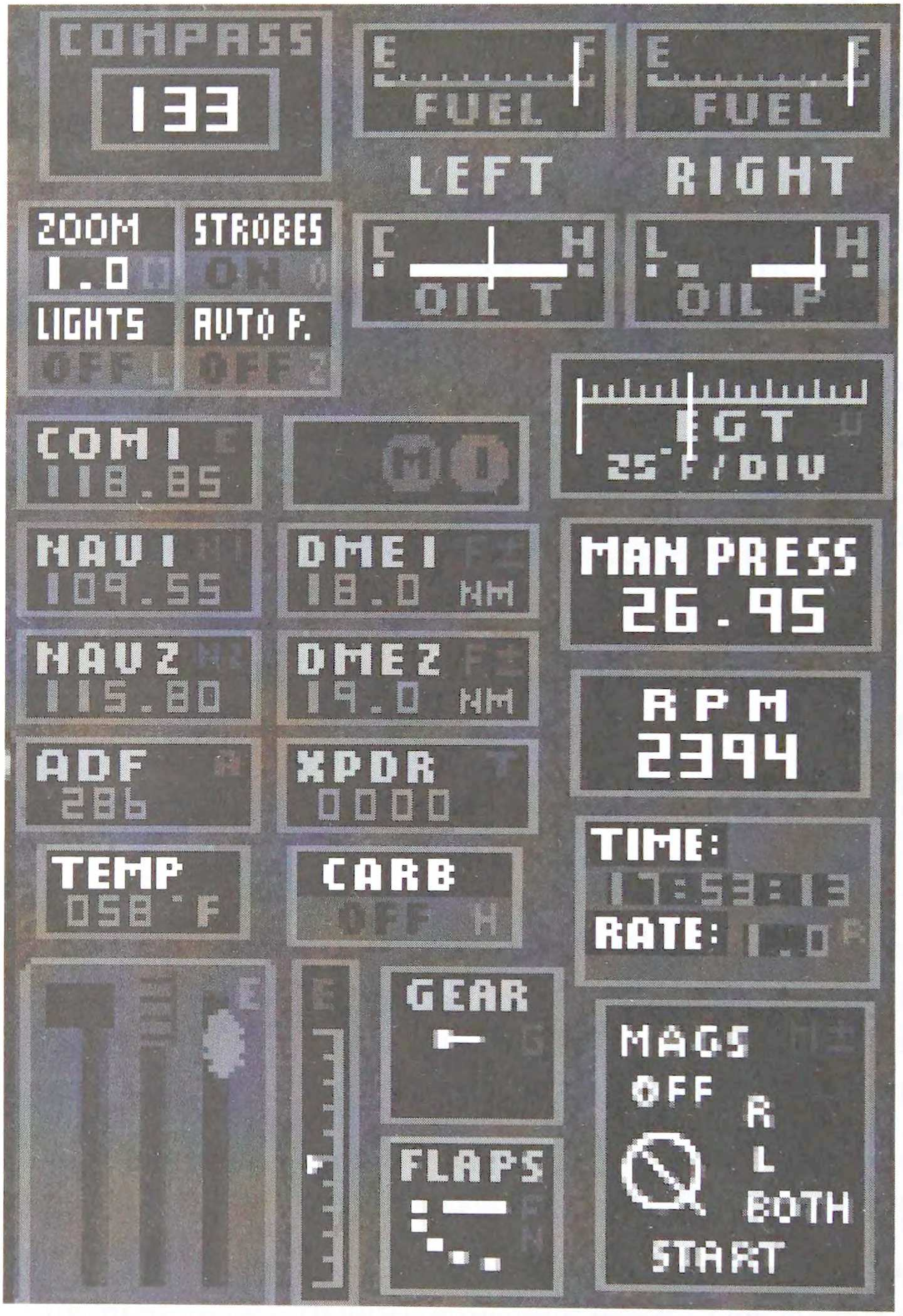

COMPASS
133
E F FUEL
E F FUEL
LEFT
RIGHT
ZOOM 1.0
STROBES ON
LIGHTS OFF
AUTO P. OFF
C H OIL T
L H OIL P
EGT 25°F/DIV
COM1 118.85
NAV1 109.55
DME1 18.0 NM
MAN PRESS 26.95
NAV2 115.80
DME2 19.0 NM
RPM 2394
ADF 286
XPDR 0000
TIME: 17:53:13
RATE: 1.0
TEMP 058°F
CARB OFF H
GEAR
FLAPS
MAGS OFF R L BOTH START

FIGURE 3.8: *The safety and maintenance instruments*

Clock

The clock measures hours, minutes, and seconds digitally in real time. To set the clock:

1. Select the menu bar.
2. Select World.
3. Select Set Time and Season.
4. Set Exact Time.
5. Type in the exact time.

TIP *You can also change the time with your mouse by clicking it on an individual clock digit.*

Gauges

Gauges include the left wing fuel tank gauge, the right wing fuel tank gauge, the oil temperature gauge, and the oil pressure gauge.

Indicators

Control position indicators are listed in Table 3.1.

Magnetos can be turned on and off for individual engines. To do this:

1. Select the menu bar.
2. Select Sim.
3. Select Engine And Fuel.
4. From the magnetos list box, select Off, Right; Left; Both, or Start,
5. Select OK.

INDICATOR	EXPLANATION
Aileron	Shows the position of the *ailerons,* the airfoils located on the trailing edge of the wing that control the movement of the plane on its longitudinal axis. When the arrow on the indicator is aligned with the center mark, the ailerons are centered. When the arrow points to the right of the center mark, the right aileron is applied and the plane will bank right. When the arrow points to the left and left aileron is applied, the plane will bank left.
Elevator	Shows the position of the *elevators,* the airfoils that control the movement of the plane on its lateral axis. Elevators pitch the plane's nose up or down. When the indicator arrow is lined up with the center mark, the elevators are centered. When the indicator arrow is above the center mark, it means that the elevators are raised. When the elevators are lined up below the enter mark, the elevators are lowered.
Rudder	Controls the rotation of an airplane about its vertical axis (left or right rotation). The right rudder is applied when the arrow points to the right of the center mark. When the left rudder is applied, the arrow points to the left.
Throttle	Shows how much throttle is applied.
Elevator Trim	Shows the elevator trim setting.
Carburetor Heat	Shows whether the carburetor heat is turned on or off.

TABLE 3.1: *Control Position Indicators*

INDICATOR	EXPLANATION
Gear	Shows whether the landing gear is lowered or raised.
Air Flap	Identifies the position of the flaps.
Magnetos	The magnetos can be switched on one at a time or simultaneously. The magnetos indicator tells you whether each of the magnetos is turned on. How to turn the magnetos on or off is explained below.
Lights	Shows whether the running lights and instrument lights are turned on. You will want the lights on at night so that the plane is visible to air traffic and ground observers. You will also want to see the instrument panel.
Strobe	Tells whether the white flashing lights of the strobes are in use.
Zoom	Shows the zoom factor of the selected window, which is bordered in white.
Autopilot Status	Indicates whether the autopilot is in operation.

TABLE 3.1: *Control Position Indicators (continued)*

NOTE *You can also start a magneto, or turn off a right or a left one.*

Indicators that Appear in the 3-D Window

Although they don't usually appear at takeoff, several indicators can appear in the 3-D window. They are the stall, overspeed axis, and brakes applied indicator. These indicators are described in Table 3.2 and shown in Figure 3.9.

To select the axis indicator:

1. Select the menu bar.
2. Select Views.
3. Select View Options. A dialog box will appear.
4. Select K Axis indicator.
5. Select an axis indicator style.
6. Select OK.

You can change the style of your axis indicator. It can be a small V, a large V, or four dots.

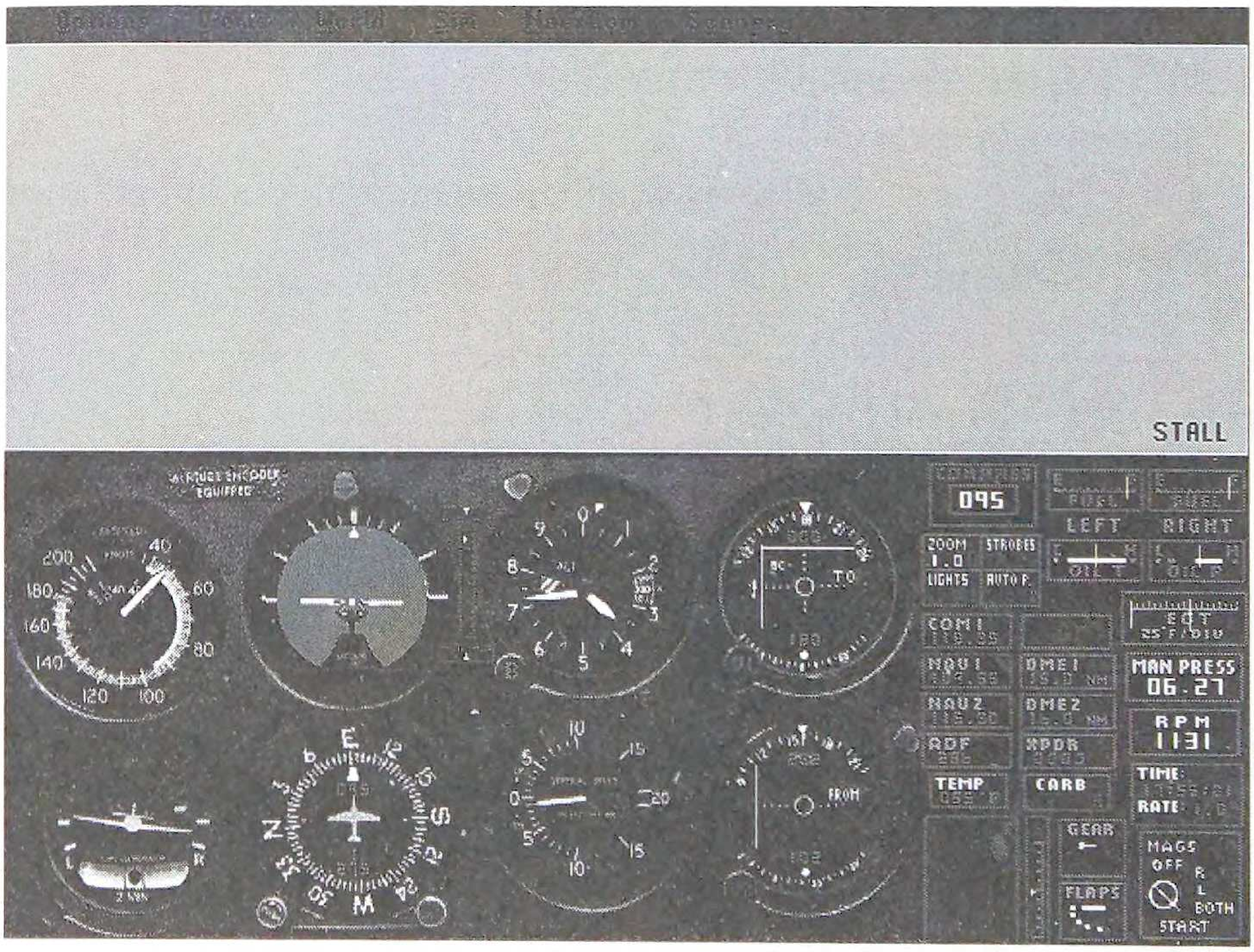

STALL
095
FUEL
LEFT
RIGHT
ZOOM 1.0
STROBES
LIGHTS
AUTO P
OIL T
OIL P
EGT
COM1
NAV1
NAV2
ADF
TEMP
DME1
DME2
XPDR
CARB
MAN PRESS
06.27
RPM
1131
TIME
RATE
GEAR
FLAPS
MAGS
OFF
R
L
BOTH
START

FIGURE 3.9: *The 3-D window indicators*

Flight Controls

An airplane has three basic flight controls: the elevator, the ailerons, and the rudder. As you might expect, the elevator controls the pitch for the climbs and the descents. The ailerons control the angle of bank, which determines the rate of turn. The rudder controls the yaw, which ensures that the tail of the fuselage follows the nose. On Flight Simulator these controls are manipulated either by the keyboard, the mouse, a joystick, a yoke, or rudder pedals (see Step 4).

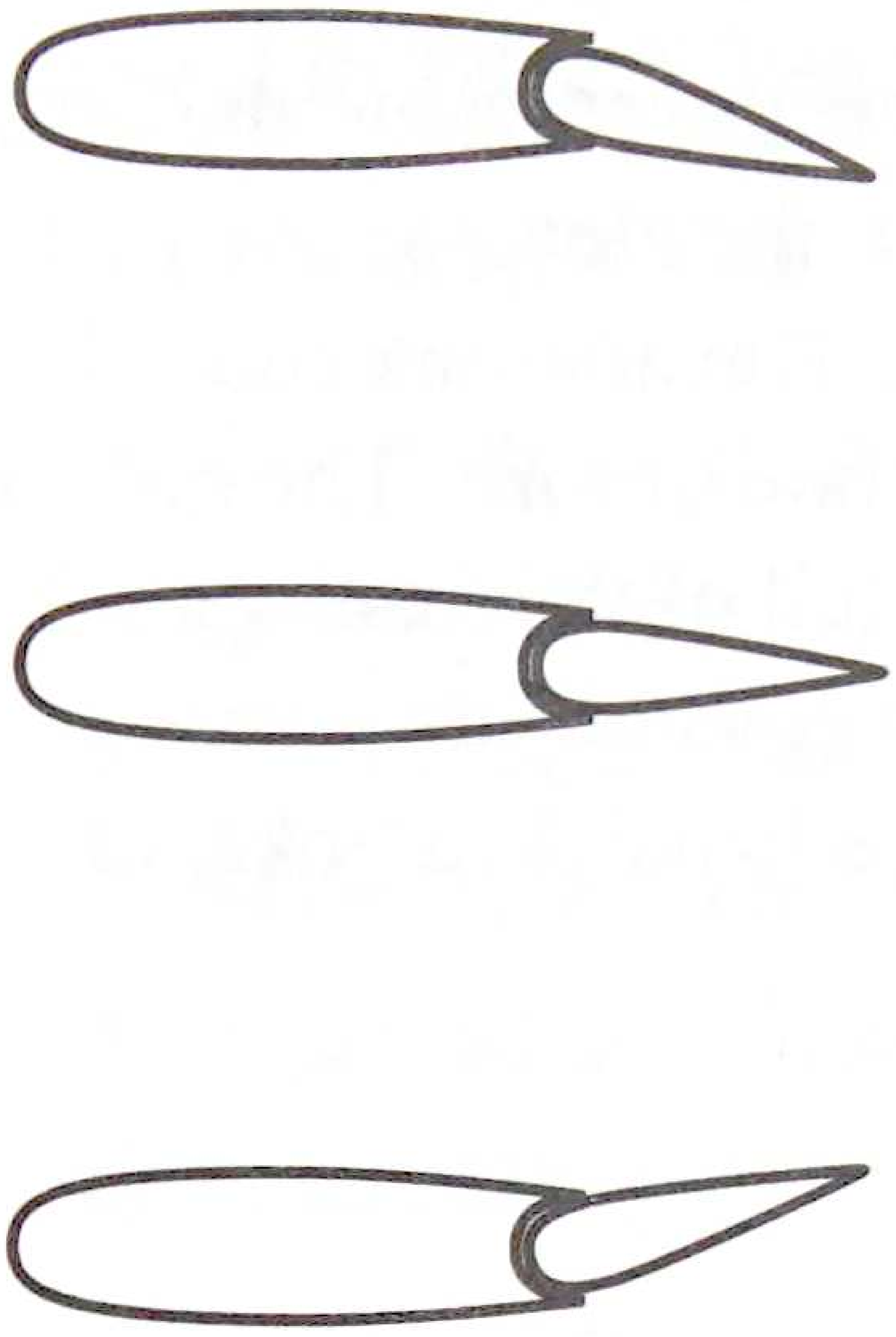
The Elevator

The elevator, which is located horizontally on the tail of the aircraft, generates lift just like the wings do. By moving the controls in the cockpit backward and forward, the elevator moves up and down. When the tail climbs, the nose of the airplane must go down an equal and opposite direction.

A stabilizer just forward of the elevator is adjusted to reduce the amount of work the elevator has to do. During a long climb, you would easily tire if you had to maintain back pressure on the control column all the way to cruise altitude. The stabilizer can be moved up or down to an infinite number of fixed positions using an actuator switch on the controls. This is what is called *trimming* an airplane.

Ailerons

The ailerons are mounted on the trailing edge of the wing near the tips. Airplanes turn like bicycles or boats. They lean towards the direction of the turn. Some wings also have speed brakes located on the top to assist in turns. Figure 3.10 shows the ailerons in use.



Lowered aileron. This increases the lift and raises the wing.

Normal aileron.

Raised aileron. This decreases the lift and lowers the wing.

FIGURE 3.10: *The ailerons*

Rudder

The rudder is located on the vertical portion of the tail. It is controlled by the rudder pedals. The rudder controls the *yaw,* the airplane's level right and left movements.

Covering Instruments and Making Them Inoperative

In Version 5 you can cover or make instruments inoperable. To cover an instrument or make it inoperative:

1. Select the menu bar.
2. Select Views.
3. Select Instrument Panel Options.

4. Select the button (Primary Instrument, Nav/Com, or Aircraft System) for the instrument you want to cover or make inoperative.
5. Select Inoperative or Covered from the appropriate list box.
6. Select OK.
7. Select OK again.

You can also randomly change the reliability of your instruments. You would do this, for example, to test your pilot skills and see how you react under trying conditions. To change the reliability of your instruments:

1. Select the menu bar.
2. Select Sim.
3. Select *R*ealism and Reliability. A dialog box appears.
4. Check the appropriate boxes and set reliability and realism levels (1 low to 8 high).

4

Controls for Running Flight Simulator

When all is said and done, Flight Simulator is a computer program, albeit a very instructive one that captures the imagination. Besides mastering all of the flight and navigation aspects of Flight Simulator, you need to know what the many commands and options are.

Besides menu commands, you control Flight Simulator by using a keyboard, the mouse, and a joystick (or joysticks). This step describes the keyboard instructions, menu commands, and mouse and joystick techniques you need to know to fly an airplane with Flight Simulator.

. . . A Quick Tour of the Keyboard Flight Controls

You do not need to purchase additional equipment to run Flight Simulator. You can use your keyboard—as long as you know which keys to press. There are three basic types of keys on any keyboard:

- The function keys. Depending on which kind of keyboard you have, function keys are located either on the top or on the left side of the keyboard.
- The standard keys.
- The numeric keypad keys.

WARNING *In Flight Simulator, function keys have different uses depending on whether they are located on top or to the left side of the keyboard. For example, pressing F1 on an enhanced keyboard (a keyboard with the function keys on top) cuts the engine, but pressing F1 on a standard keyboard (a keyboard with the function keys on the left side) sets the flaps up. Be sure you know which kind of keyboard you have and are pressing the right function keys.*

Function Key Flight Controls

Figure 4.1 shows the function keys along the top of the enhanced keyboard and how they work in Flight Simulator. Figure 4.2 shows the function keys on the left side of the standard keyboard and how they work. Tables 4.1 and 4.2 list these function keys.

TIP *You might want to mark the pages in this book where the function keys are described. You will often need to know what the function keys do as you master Flight Simulator.*

KEY	USE
F1	Cut the engine
F2	Reduce throttle
F3	Increase throttle
F4	Use full throttle
F5	Set flaps up
F6	Set flaps to 10°
F7	Set flaps to 30°
F8	Set flaps do

TABLE 4.1: *Function Keys along the Top of the Keyboard*

KEY	USE
F1	Set flaps up
F2	Use full throttle
F3	Set flaps to 10°
F4	Use full throttle
F5	Set flaps to 20°
F6	Increase throttle slowly
F7	Set flaps to 30°
F8	Reduce throttle
F9	Set flaps down
F10	Cut the engine

TABLE 4.2: *Function Keys along the Left Side of the Keyboard*

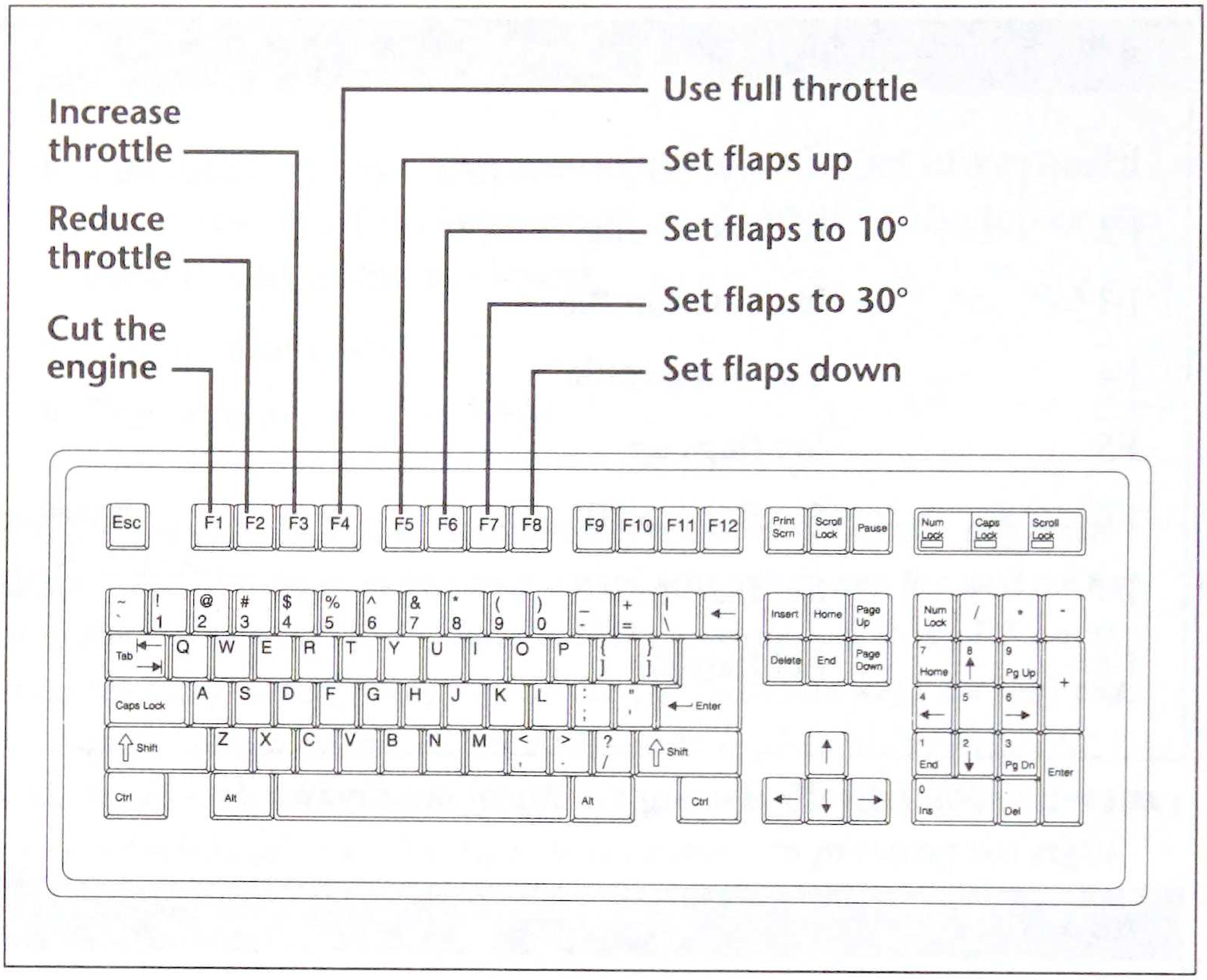

Increase throttle
Reduce throttle
Cut the engine
Use full throttle
Set flaps up
Set flaps to 10°
Set flaps to 30°
Set flaps down
Esc
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
F11
F12

FIGURE 4.1: *Function keys on top of the keyboard*

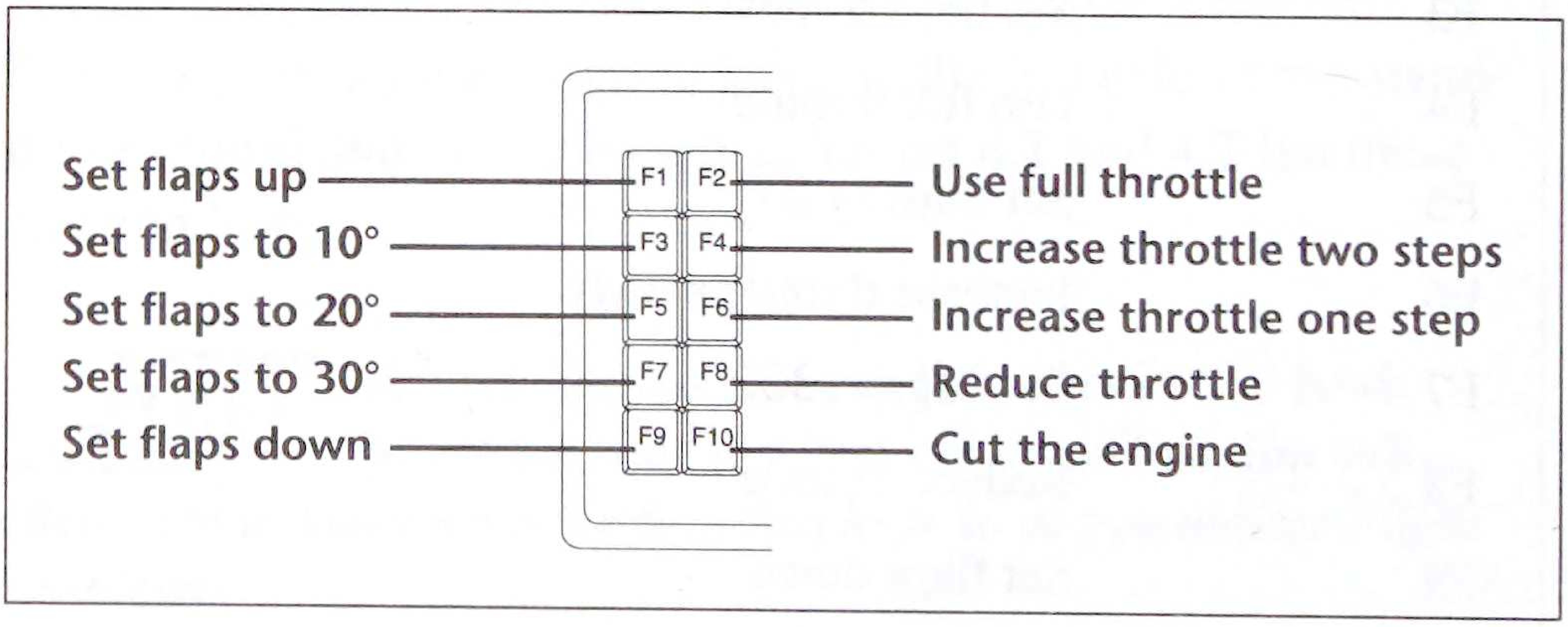

Set flaps up
Set flaps to 10°
Set flaps to 20°
Set flaps to 30°
Set flaps down
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
Use full throttle
Increase throttle two steps
Increase throttle one step
Reduce throttle
Cut the engine

FIGURE 4.2: *Function keys on the left side of the keyboard*

Numeric Pad Flight Controls

Table 4.3 explains what the numeric keys do. Figure 4.3 shows these keys with labels.

KEY	USE
1	Set elevator trim up
2	Pitch nose up
3	Reduce throttle
4	Set left ailerons
5	Set center ailerons
6	Set right ailerons
7	Set elevator trim down
8	Pitch nose down
9	Increase throttle
0	Turn rudder left
Enter	Turn rudder right

TABLE 4.3: *Numeric Pad Flight Controls*

Main Keyboard Flight Controls

The main keyboard flight controls are listed in Table 4.4 and shown in Figure 4.4. These keys all control certain flight instruments, flight capabilities, and landing capabilities.

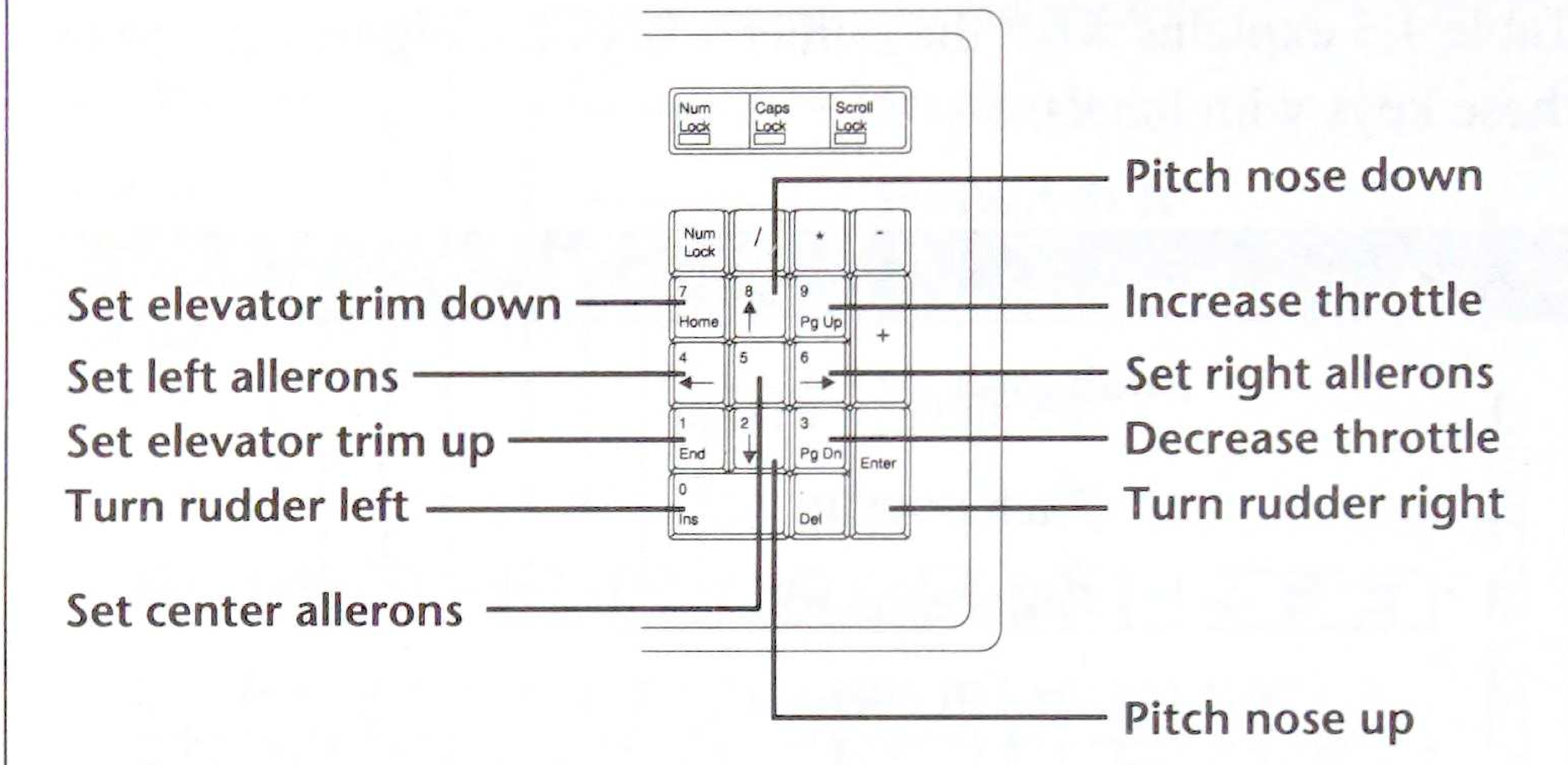

Num Lock
Caps Lock
Scroll Lock
Num Lock
/
*
-
7 Home
8
9 Pg Up
+
4
5
6
1 End
2
3 Pg Dn
Enter
0 Ins
Del
Pitch nose down
Set elevator trim down
Increase throttle
Set left allerons
Set right allerons
Set elevator trim up
Decrease throttle
Turn rudder left
Turn rudder right
Set center allerons
Pitch nose up

FIGURE 4.3: *Keys on the main keypad*

KEY	USE
A	Controls the Automatic Direction Finder
B	Calibrates the altimeter
C	Tunes Com radio
D	Calibrates the gyroscope
f	Toggles DME speed to distance setting
G	Controls landing gear
H	Turns carburetor heat off and on
I	Turns smoke and spray off and on
J	Turns jet starter on and off
L	Turns lights off and on

TABLE 4.4: *The Main Keyboard Flight Controls*

KEY	USE
N	Tunes Nav radios
O	Turns strobes on and off
P	Pauses and restarts simulation
Q	Turns sound on and off
S	Changes view from selected 3-D window
T	Selects transponder code
V	Chooses OBI heading for VOR station
X	Lands the plane automatically
Z	Turns Autopilot on and off
Backspace	Restores 1 × Zoom
Esc	Turns the menu bar on and off
NimLock	Actives the map window
Print Scm	Resets the flight mode
.	Turns brakes on and off
;	Saves a situation

TABLE 4.4: *The Main Keyboard Flight Controls (continued)*

Keys for Controlling Windows and Views

Table 4.5 is a summary of all keyboard functions for controlling windows and views.

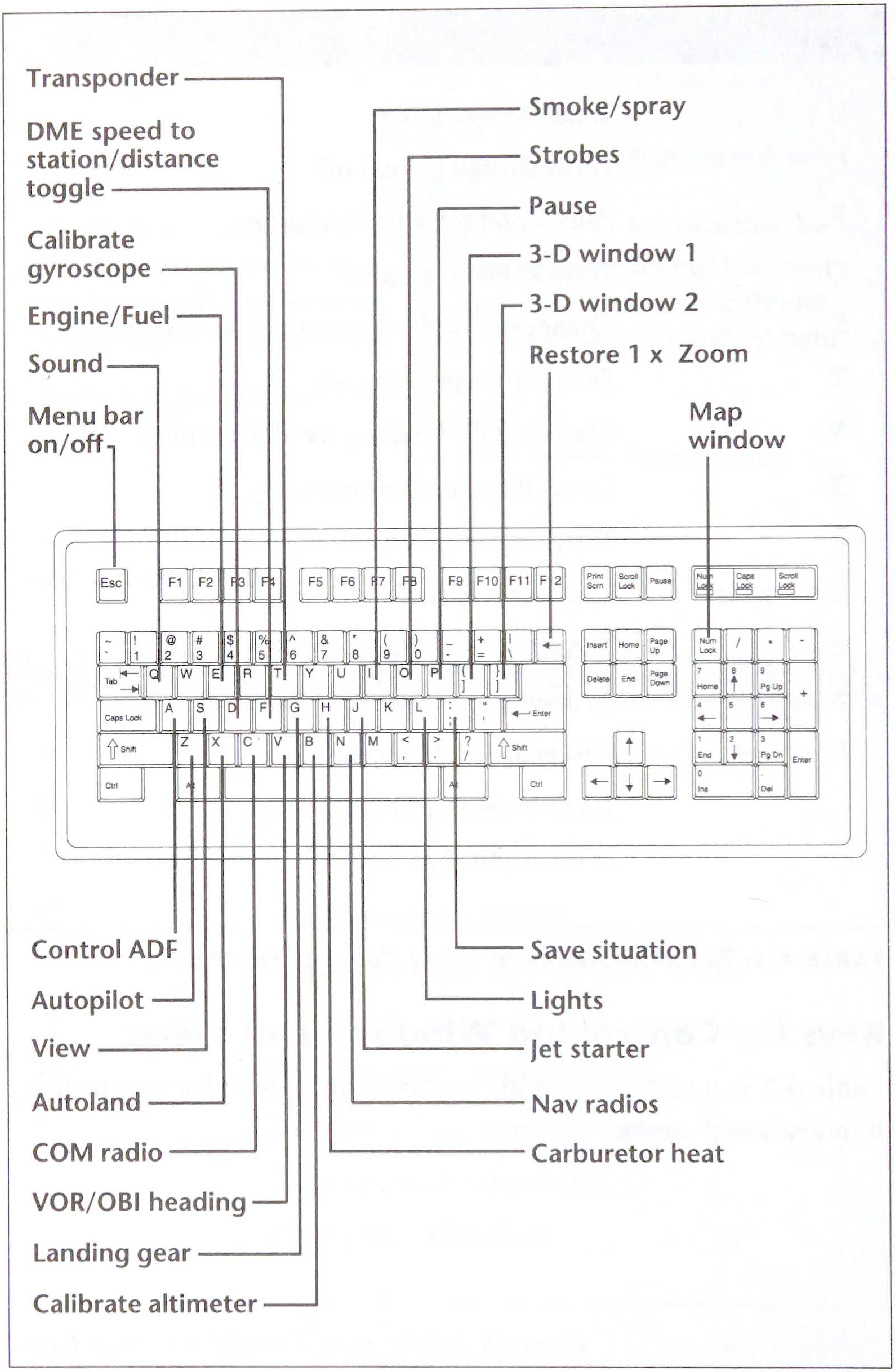

Transponder
DME speed to station/distance toggle
Calibrate gyroscope
Engine/Fuel
Sound
Menu bar on/off
Smoke/spray
Strobes
Pause
3-D window 1
3-D window 2
Restore 1 x Zoom
Map window
Control ADF
Autopilot
View
Autoland
COM radio
VOR/OBI heading
Landing gear
Calibrate altimeter
Save situation
Lights
Jet starter
Nav radios
Carburetor heat

FIGURE 4.4: *Keys on the main keyboard*

Getting Acquainted with the Menus

The menu bar is located at the top of the screen. As shown in Figure 4.5, it contains the menus you use to control Flight Simulator. To select a command on the menu bar, press the Alt key

PRESS	ACTION
S	Allows you to cycle through the three view modes—Cockpit, Tower, and Spot
[	Selects 3-D window 1
[[	Turns off 3-D window 1
]	Selects 3-D window 2
]]	Turns off 3-D window 2
NumLock	Selects the map window
NumLock+ NumLock	Turns off the map window
+	Makes large zoom-in adjustments
Shift+plus key (+)	Makes small zoom-in adjustments
–	Makes large zoom-out adjustments
Shift+minus key (–)	Makes small zoom-out adjustments
Shift+ numeric keypad key	Changes view direction (after pressing Shift, press a numeric key on the numeric keypad to adjust the view)
Shift+ Backspace	Pans up in Cockpit or Spot mode
Shift+Enter	Pans down in Cockpit or Spot mode

TABLE 4.5: *Controlling Windows and Views*

along with the underlined letter. For example, to select Options on the menu bar, press Alt+O. To select a menu with the mouse, point to the menu name and click the left mouse button.

TIP ***The menu system is active when it appears at the top of the screen. If the menu bar is not visible, you can activate it. To activate the menu bar, press Escape.***

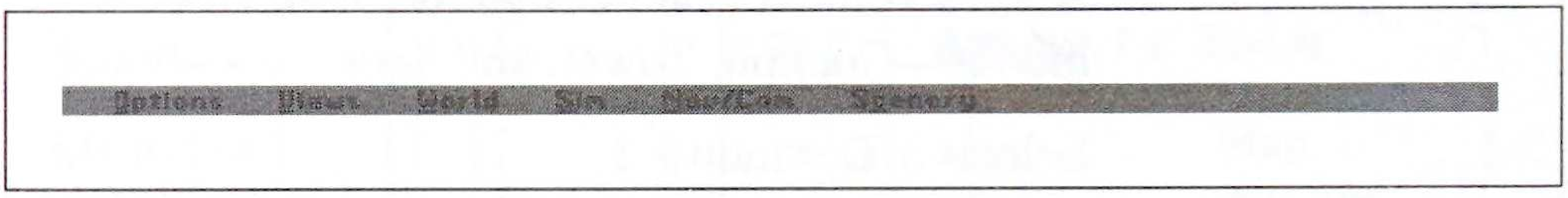


FIGURE 4.5: *The Flight Simulator main menu*

The options on the main menu bar are:

OPTIONS	USE
Options	Allows you to configure and set your preferences for running Flight Simulator.
Views	Controls what you see on your computer screen.
World	Controls where the airplane is placed and allows you to adjust locations. Also controls weather.
Sim	Allows you to adjust how much realism is in the simulation.
Nav/Com	Allows you to configure and establish navigational settings.
Scenery	Allows you to determine and configure the scenery settings.

Standard Menu Conventions

Menu options follow standard conventions. After you select a menu, a list of options is displayed below the menu name. You select these options either by pressing or clicking the underlined letter. Menus in Flight Simulator follow the standard conventions for menu names:

CONVENTION	MEANING
✓	A check mark on a menu means that the option is selected.
...	Three dots (an ellipsis) after an option means that selecting it will display a submenu.
hot key	A letter on the right side of a menu option is the *hot key.* Pressing the hot key activates the command immediately.

TIP ***When two commands are listed, the first command turns it on and the second turns it off.***

The various options on the menu bar are explained in detail below.

The Options Menu

Options is the menu for all of your most broad selections. The choices on this menu are as follows:

Normal Flight *or* Entertainment	Lets you toggle beyween normal and entertainment flights.Entertainment flights include navigational challenges, including crop dusting and flying alongside another pilot

Quick Practice	Allows you to select introductory setups for learning various aspects of flying. This option gives you many opportunities for practicing landing.
Flight Instruction	Lets you choose among ten different flying lessons.
Land Me	Gives control of the plane to Flight Simulator so you can land automatically.
Instant Replay	Shows you what you just did so you can enjoy a past moment of flying or see what you did wrong.
Video Recorder	Lets you play back flights stored in Flight Simulator or record your own flights.
Flight Analysis	Lets you analyze your landings or maneuvers.
Logbook	Lets you review your logbook as well as make new entries.
Situations	Lets you choose environments for flying.
Save Situation	Lets you save a flying situation so you can go back to it. Once the situation is saved, it is stored on the Situations menu.
Reset Situation	Resets a situation to what it was when originally loaded.
Aircraft	Lets you choose a type of aircraft to fly.
Simulator Info	Gives you a readout of what situation you are in, and the airplane you are in. Also displays available memory.

Preferences	Lets you configure the hardware of your computer for running Flight Simulator.
Exit	Lets you exit Flight Simulator.

WARNING ***One of the biggest problems new pilots face is making turns with the mouse and keyboards. Be sure to use the calibration options on the Preferences Menu to make these control features less sensitive. Many pilots find that a setting of 2 works much better here than the default setting.***

One of the most important options on the Options menu is Preferences. The Preferences menu lets you change the system settings of Flight Simulator. If you want to run in video mode, select Display, and you can change the mode to your liking. You may also change the audio drivers, as well as sensitivity settings for the keyboard, mouse, and joystick. You can change the setting for the instrument panel to make it more readable or update its readings faster. Feel free to experiment with the settings and see what works best for you.

The Flight Instructions option on the Options menu is one of the most important menu items for the student pilot. This option lets you select a flight lesson. You can toggle between instructor mode and student mode by using the check box. Select the student mode when you want to try maneuvers yourself, and the instructor mode when you just want to watch Flight Simulator fly your airplane.

Views Menu

Views has a narrow focus. It allows you to change the way you are looking at your on-screen performance. Following is an explanation of the options on the Views menu:

View 1	Lets you toggle View window 1 on and off. The default is the Cockpit view, but you can change views.
View 2	Lets you toggle View window 2 on and off. The default is a small, inset window in View 1 that shows the Spot view.
Map View	Lets you turn the Map View window on and off.
Instrument Panel	Lets you turn the instrument panel on and off.
Instrument Panel Options	Displays a submenu for configuring the instruments on the instrument panel.
Mini Controls	Displays a small window for viewing basic aircraft control information—the ailerons, the elevator, rudder, throttle position, and airspeed. This is a toggle.

TIP *The Mini Controls option enlarges your view from the cockpit. Mini controls take up less space than the control panel instruments.*

Set Spot Plane	Lets you set the spot plane position.
View Options	Lets you configure the various View windows—View 1 and 2 and the Map view.
Maximize Window	Makes the window fill the screen.
Size and Move Windows	Lets you move the windows around.
Flight Photograph	Lets you use the built-in screen capture program to save the view to a PCX graphics file.

World Menu

TIP ***To change scenery, you need to go to the Scenery menu. The World menu is for setting locations and changing weather, time, wind, clouds, and seasons.***

The World menu allows you to change the conditions of the world outside your airplane. In other words, it allows you to alter environmental factors. Following is a description of the World menu options.

Slew	Lets you interactively move the plane around the world. You can move wherever you want quickly without regard to weather and other variables.
Airports	Lets you place yourself at any airport in Flight Simulator.

Set Exact Location	Lets you set the location of the airplane or control tower to any latitude or longi-tude. Or you can use Flight Simulator's X/Z coordinates.
Set Time and Season	Lets you set the time of day for your flight, as well as the season.
Weather	Lets you establish the temperature, barometer settings, and wind settings.

Use the World menu to change locations quickly. There are three ways to do this—by slewing, selecting an airport, or setting an exact position.

- Slewing lets you pause the simulation and slide over the landscape (ignoring all known laws of physics and gravity) until you get where you want to go. After that, you can resume flying as usual.

TIP ***Slewing is great fun. When you see something in the distance you want to check out, you can simply "slew" to it.***

- To select an airport, simply choose the scenery area that you want to fly around in and select an airport from that area. Flight Simulator gives you a number of areas in the continental United States to fly in, as well as a few areas in Europe.
- With the Set Exact Location option, you can enter latitudinal and longitudinal coordinates to place yourself anywhere you want. You may also specify an initial heading and altitude.

TIP ***Set your altitude at around 10,000 feet or higher if you are going someplace you have never been before. You do not want to go somewhere new and find yourself underground once you get there.***

Sim Menu

The Sim menu is dedicated to making adjustments. This is where you make changes that affect the feel and performance of all other menu activities and your flights in general. Following is a description of the Sim options:

Sound	Toggles sound on and off.
Pause	Lets you pause and unpause the flight simulation.
Crash Detection	Lets you take off after crashes. Without crash detection on, the airplane stops.
Simulation Speed	Lets you set the rate at which Flight Simulator flies.
Auto Coordination	Toggles auto-coordination. With auto- coordination on, the ailerons and rudder will work correctly together when you make turns.
Smoke System	Lets you turn the smoke that comes out of your plane on or off.
Realism and Reliability	Lets you set how realistic the flight model is, as well as how reliable the plane is. Without reliability on, the systems can give you false readings. This can be a fun challenge.

Engine and Fuel	Lets you configure fuel levels and magneto settings.
Calibrate Altimeter	Lets you calibrate the altimeter for different barometric pressures.

Reliability is an important feature. Unless you adjust the reliability, your instruments will start falling off your instrument panel at random. To prevent this absurdity, which is the airplane equivalent of leprosy, make sure you set reliability to 100 percent. But if you want the challenge of flying a crippled airplane, you can try a lower setting.

Instrument failure is rare, but it does happen. Preparing for instrument failures is an important part of real-life flight training. Dr. Ed Kleinman of Indian Hill, Ohio, for example, recalls the time his instruments failed during a night flight. “What happened was that my alternator/generator belt broke and my electrical panel went out. I couldn’t see and you bet I was scared. The funny thing is that my instructor used to turn off the instrument when he was training me. I would get mad when he did and complain, ‘Hey this never happens!’ Well it did. And I could almost see the ghost of my old instructor sitting beside me telling me, ‘I told you so.’ ”

Nav/Com Menu

Nav/Com is short for navigation/communications. That is why you find commands to work with navigation on this menu as well as the related communications commands for using radios and other systems effectively. Following is an explanation of the Nav/Com menu options:

Autopilot	Lets you turn autopilot on and off and adjust the various settings.

Air Traffic Control	Let's you turn air traffic control on and off. With air traffic control, you get messages from the control tower during landings.
EFIS\CFPD	Provides a flight path to follow. Options include rectangles and even a "yellow brick road." Use this option for help with navigation.
Communication Radio	Lets you change the frequency of your Com 1 and adjust the communication rate.
Navigation Radius	Lets you set and adjust Nav1 and Nav2.
Transponder	Lets you adjust your transponder code setting.
ADF	Lets you adjust the ADF frequency.

Scenery

The Scenery menu gives you limited control over scenery. The options are described below.

Scenery Library	Lets you select a scenery area of your choice. Flight Simulator offers only one choice, but you can buy add-on scenery modules for Europe and elsewhere.
Scenery Complexity	Lets you determine the details of scenery. For example, when flying over a city you can view buildings and streets below.

Dynamic Scenery	Lets you turn on planes, air traffic, and other dynamic objects.

Removing Menus

When you select options that generate new menus, you may end up with overlapping menus on the screen. You can remove the menus one at a time, or you can remove them togeather as a group.

- To remove a menu you are currently using, press Escape. You can press Escape again to bring the menu back.
- To remove one menu at a time, make sure the mouse is outside of the menu and click the left mouse button.

The Mouse

You are probably familiar with using a mouse from working with Windows and other applications. You use a mouse to move around the screen and activate icons. In order to master your mouse, you will need to understand pointer mode, yoke mode, calibration, and how to make sensitivity adjustments.

When Flight Simulator starts running, a pointer appears on the screen. Moving the mouse moves the pointer. The mouse moves in two modes: pointer mode and yoke mode. You press the right mouse button to go back and forth between these two modes.

Pointer Mode

In pointer mode, the mouse selects menu options. In short, you move a pointer (arrow) around the screen by moving the mouse. You then select menus and options by clicking the left button. You can also adjust instruments on the instrument panel by pointing to an instrument and clicking the left mouse button. This procedure should be familiar to anyone who has used a mouse in Windows application programs.

In some cases, you click the mouse to turn on an instrument. For example, click the lights indicator to turn the lights on and off. On the other hand, you can use the mouse to adjust some instrument settings. If you point to the left side of the digits of the OBI and click the left button, the instrument setting decreases. Pointing to the right side and clicking the left button increases the setting.

Control Yoke Mode

Using the mouse in control yoke mode is similar to using a joystick. The mouse acts as a control yoke or stick. With the right button held down, you can use the mouse to move your airplane in four directions:

- Nose down
- Nose up
- Right bank (right aileron)
- Left bank (left aileron)

These basic motions are shown in Figure 4.6

By moving the mouse forward or backward you control the airplane's pitch. In other words, you point the nose down or up. Moving the mouse to the right will turn the airplane to the right. Moving the mouse to the left will turn the airplane to the left.

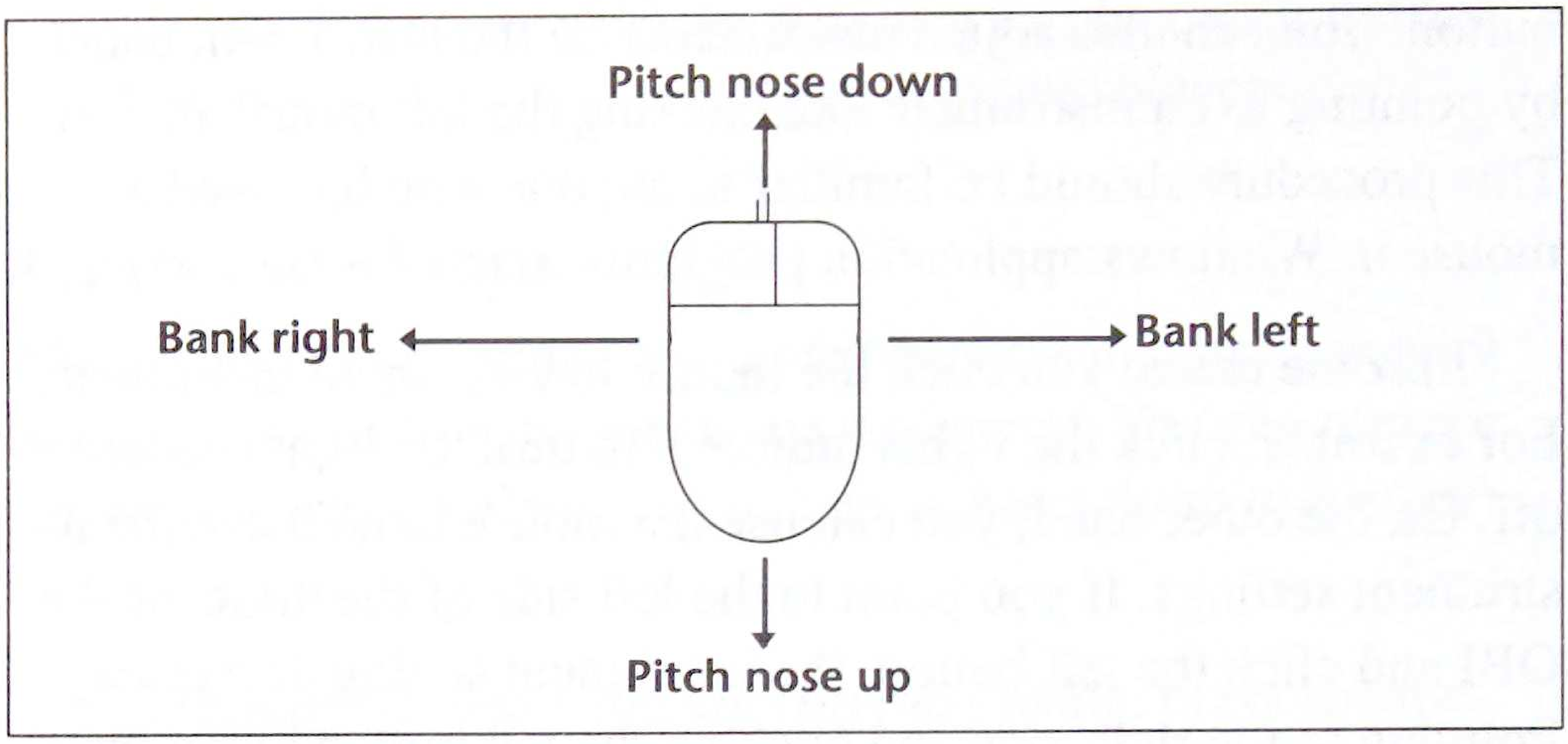


FIGURE 4.6: *Basic mouse motions*

By holding down the left button and dragging the mouse forward, you can increase the throttle. On the other hand, holding down the left button and dragging the mouse backward decreases the throttle. You can monitor your progress by watching the control panel.

Pushing down the left button and dragging the mouse to the left applies the brakes. Of course, the brakes only work when you are on the ground. A brake indicator near the bottom of the 3-D screen will tell you when the brakes are applied. Flight Simulator will release your brakes when you leave the ground. You can also hold the left button down and drag the mouse to the right to release the brakes.

• • • Joysticks

Joysticks take two basic forms:

- Self-centering, which means that the stick returns to the center position when released.

- Noncentering, in which case the stick stays put when released.

You can use either form of joystick for ailerons and rudder control. However, you need a noncentering joystick to control the elevators and the throttle.

In some cases, a joystick can convert from self-centering to noncentering with the flip of a switch. These switches can usually be found on the underside of the joystick. In some cases, you can also disable the self-centering mechanisms on joysticks that do not have levers. You should not, however, try to do this without consulting the joystick manufacturer first.

Calibration

You will want to test your instruments. Move the joystick through all of its movements. Sometimes the movements may be jumpy. Other times, moving the joystick in a specific direction will not cause the ailerons or elevators to follow. In any event, you should use the following calibration procedures to compensate for joystick tolerance. It will also compensate for joysticks that deviate from IBM specifications, currently with the specifications O-lOOK-ohm resistance and linear response.

To adjust joystick sensitivity:

1. Select the menu bar.
2. Select Options.
3. Select Preferences.
4. Select Joystick. A dialog box appears.
5. Make the appropriate adjustments.

Adjustments are made according to scale from 1 to 8, with 1 being the lowest level of sensitivity and 8 being the highest level. To change a setting, select the option you want to adjust, and then press the number representing the sensitivity you want.

6. Select OK.

TIP *You can select a number with the mouse by dragging the pointer to the setting you want.*

You can save joystick sensitivities and joystick action selections as a part of a flight mode by choosing Save Situation.

WARNING *Some people prefer to use both a joystick and a mouse. While this is possible, adjustments have to be made. If Joystick A or B is active, it overrides the mouse yoke controls. On the other hand, mouse pointer functions are still active when joysticks are used.*

Using Mach II and Mach III Joysticks with Flight Simulator

You can use Mach II and Mach III joysticks with Flight Simulator. The joystick can be connected to either a CH Products game card or an IBM PC/XT/AT/PS2 or compatible game card. Both the Mach II and the Mach III joystick provide two axis cursor controls and two push button switches. The Mach III provides an additional push button on the top of the handle that duplicates the function of one of the push buttons.

You can use either the rotary control knob located to the left or the one located above the stick handle to center the joystick handle. The top side (above) is where the cord connects.

These joysticks also contain mode slide switches to allow either spring self-centering or noncentering modes. Moving the switches toward the lower-right corner of the joystick box (closest to each other) puts the joystick in self-centering mode.

ACTION ***Once the joystick is centered as preferred, proceed through the initial Flight Simulator startup screens and respond Yes when asked to use the joystick.***

5

The Logbook

Pilots keep track of the hours they fly by recording them in *logbooks*. Flight Simulator's logbook format looks very much like an official logbook, but is simplified. The Flight Simulator logbook will record:

- The date of your flights
- The aircraft models used
- Instruction hours
- Day/Night hours

WARNING ***The logbook will not record flights less than six minutes long.***

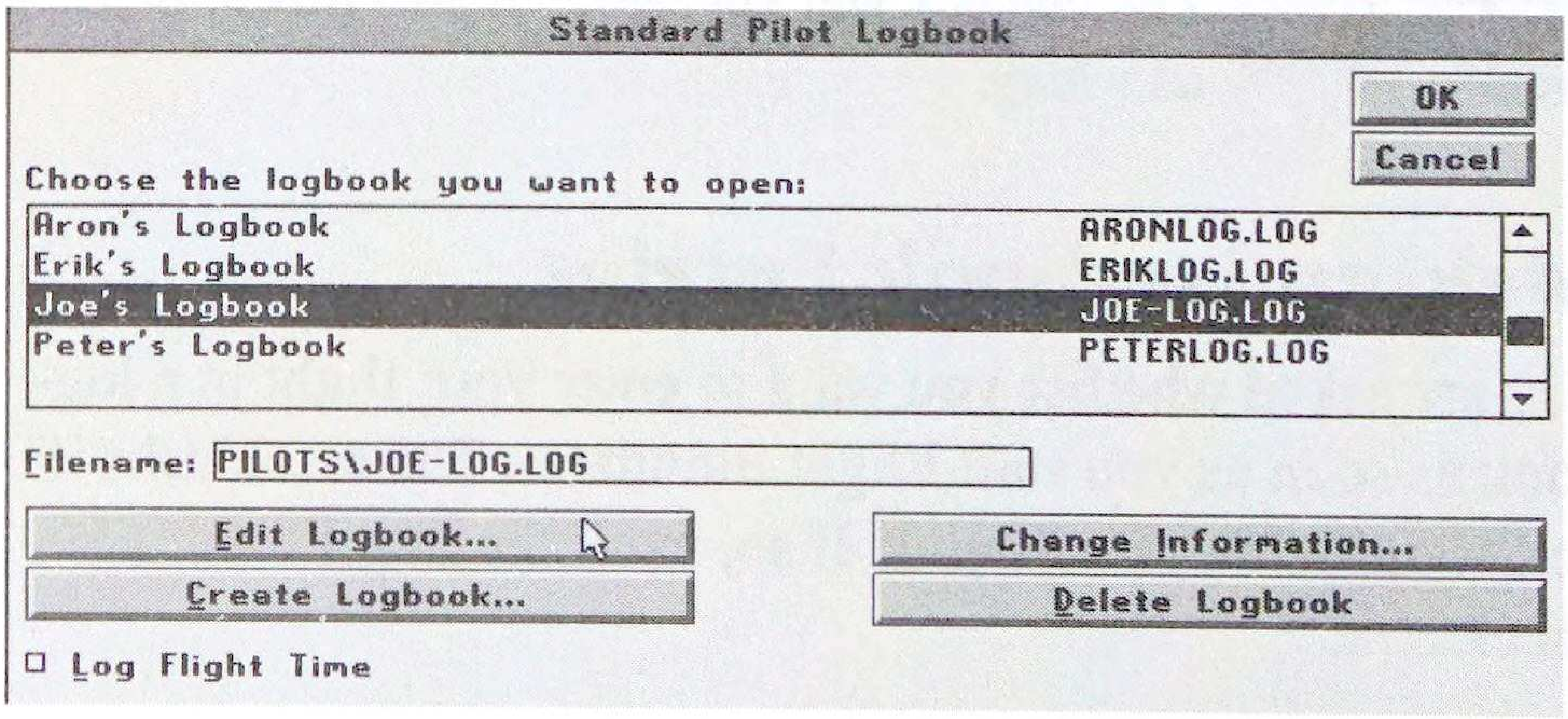
Making Logbook Entries

You are asked whether you want to enter your flight in a logbook as soon as you start Flight Simulator. The menu asks if you want to log your flights. If so, mark the Log Flight check box.

Once you're past the startup stage, you have to use the Log book commands. Logbook commands are found under the Logbook dialog boxes in the Options menu. Making entries in the logbook is a little trickier than you might first expect. First you need to create a logbook. Then you tell the logbook you are going to make an entry. Then and only then can you make the entry. Once you have made an entry, you have to tell the logbook you are ready to edit it. Only then can you edit it.

To create a logbook:

1. Select the menu bar.
2. Select Options.
3. Select Logbook. A Create Logbook dialog box appears, as shown in Figure 5.1.
4. Select Create Logbook. A second dialog box appears.
5. Select OK. You are returned to the Create Logbook dialog box.
6. Select the Log Flight Time check box. You can now manually log your flight time.
7. Select OK.



Standard Pilot Logbook

Choose the logbook you want to open:

Aron's Logbook	ARONLOG.LOG
Erik's Logbook	ERIKLOG.LOG
Joe's Logbook	JOE-LOG.LOG
Peter's Logbook	PETERLOG.LOG

Filename: PILOTS\JOE-LOG.LOG

☐ Log Flight Time

FIGURE 5.1: *The Create Logbook dialog box*

If you want to automatically log your flight time:

1. Select Options.
2. Select Preferences. A dialog box appears.
3. Select Log Flight Time.

TIP ***Of course, the Log Flight Time box will already be checked if you selected it during setup.***

Editing a Logbook

Logbooks have names up to eight letters long and a .log extension. Some of you may not want to name your book Standard Pilot Log. My logbook is stored under the file name joe.log. Many pilots use their first or last names for logbook titles.

You can edit a Pilot Log. To edit the logbook:

1. Select the menu bar.
2. Select Options.
3. Select Logbook. A Standard Logbook dialog box appears.
4. Select Edit Logbook. A dialog box appears.
5. Either select Edit Entry to edit an entry, or select Delete Entry to delete an entry.
6. Select Save. You will return to the previous dialog box.
7. Select OK.

6

Analyzing Your Flights

Those of you who expect Flight Simulator to provide psychoanalysis to explain why you crash so often will be disappointed. Flight Simulator does not come with a built-in psychologist or psychiatrist. However, Flight Simulator does provide for more down-to-earth analyses: the program will look at your actual flight and tell you what happened so you can find out what you did right and what you did wrong.

Of course, you can remember in general terms what happened each time you fly an airplane, but it's hard to recall your exact flight path. Flight analysis will give you feedback on your flight path so you can review your flight and know *for sure* what went wrong and what went right. Flight Analysis is found on the Options menu and includes the following types of analyses:

- Landing analysis
- Maneuver analysis
- Course tracking

NEW *Those of you familiar with Version 4 will notice a small semantic change in Version 5. "Course Plotting" has become "Course Tracking." As you will see, there have been a few changes in how that facility works.*

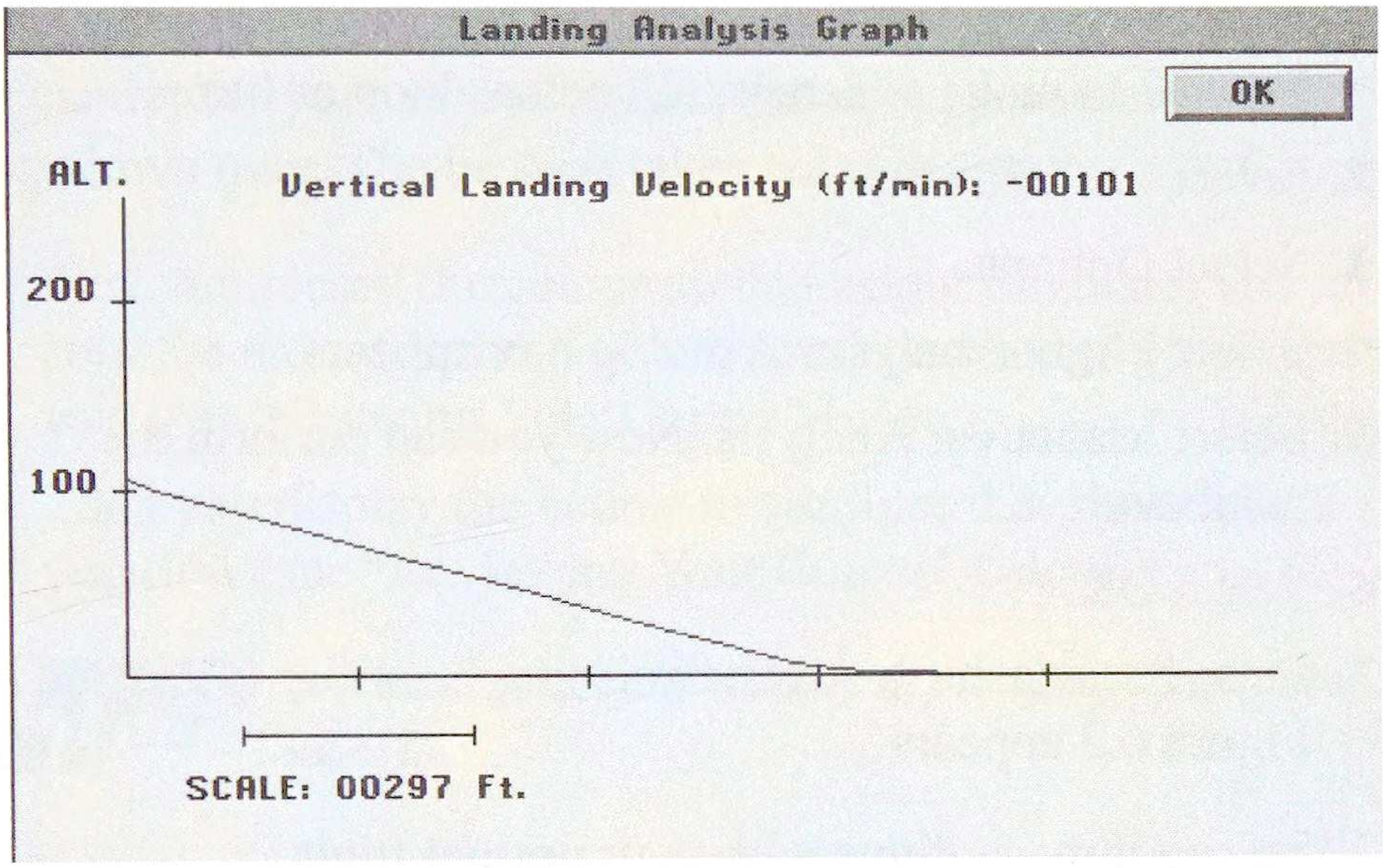
You can also analyze your crashes by using the Sim menu with the Crash Detection option.

TIP *You can use the Instant Replay to see up to 60 seconds of your flight, but it does not provide analysis of any kind.*

• • • Landing Analysis

Landing analysis monitors your landing from the time you are one hundred feet above the runway to the time your airplane comes to a stop. You will see a graph showing your flight path and vertical velocity. To activate landing analysis, set up a landing approach. When you are more than one hundred feet above the runway:

1. Select the menu bar.
2. Select Options.
3. Select Flight Analysis. A dialog box appears.
4. Select Landing Analysis.
5. Select OK. You will be returned to the screen.
6. Make the landing. A graph will appear similar to the one in Figure 6.1.
7. Select OK. You can resume your flight.



Vertical Landing Velocity (ft/min): -00101

SCALE: 00297 Ft.

FIGURE 6.1: *A landing analysis graph*

TIP *The graph will not appear until your airplane rolls to a stop.*

Maneuver Analysis

Landing is only one maneuver you can study with the flight analysis feature. You can study any maneuver. Maneuver analysis works very much like landing analysis, except

- it is not triggered by the 100-foot rule;
- course recording begins the moment you leave the Flight Analysis menu;
- course recording ends when you press the backslash key (\).

TIP *Manuever analysis is the only feature on Flight Simulator that uses the backslash key (\ ).*

To activate a maneuver analysis:

1. Prepare to make a maneuver, such as loop or turn.
2. Select the menu bar.
3. Select Options.
4. Select Flight Analysis. A dialog box appears.
5. Select Maneuver Analysis. Now you can perform the maneuver.
6. Select OK.
7. Press backslash (\). An analysis graph similar to the one in Figure 6.2 appears.

You can now continue with your normal flight.

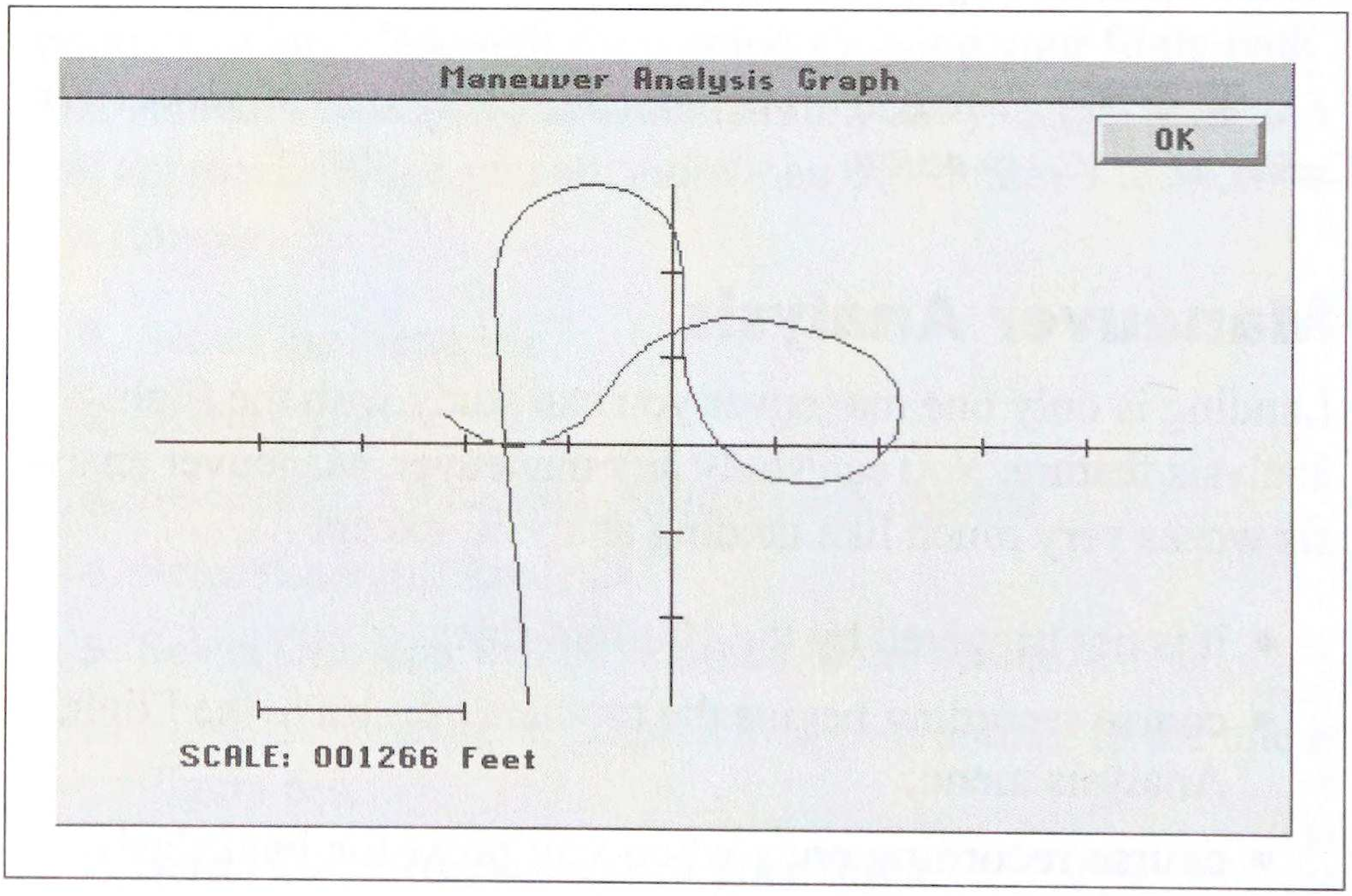


FIGURE 6.2: *A maneuver analysis graph*

Course Tracking

You can replay your course against the scenery you have already flown over. The process takes place in two steps:

- First you record the course so that Flight Simulator can record the aircraft's three-dimensional position at preset intervals (see "Tracking Your Course" below).
- Then you display the course to see lines that show where you flew (see "Reviewing Your Course" below).

TIP ***You can record and display at the same time if you want to.***

To track the course you're on:

1. Prepare to make a maneuver, such as a loop or turn.
2. Select the menu bar.
3. Select Options.
4. Select Flight Analysis. A dialog box appears.
5. Select Course Tracking. The lower half of the dialog box lights up.
6. Select Record Course.
7. Select OK.

Course tracking puts a line behind your airplane to let you know where you have been. The Track length box, in turn, defines how much of your path is mapped.

TIP ***If you turn on Course Tracking and fly in a circle you should return to your original path. You can also search for your path from the Tower or Spot view or by pressing Shift and a numeric-pad arrow key.***

The course buffer—the area in memory where the course plot is kept—is limited in space. The program will automatically erase the oldest part of your course plot if it runs out of buffer space. However, you have options for minimizing these problems.

If you don't have a lot of memory:

- Set the Course Tracking resolution to Coarse.
- Set the resolution to Fine in the Flight Analysis dialog box from the Options menu.

Reviewing Your Course

To review a course that you have tracked:

1. Prepare to make a maneuver, such as loop or turn.
2. Select the menu bar.
3. Select Options.
4. Select Flight Analysis. A dialog box appears.
5. Select Course Tracking. The bottom half of the dialog box lights up.
6. Select Display Course. As shown in Figure 6.3, you will see a projection of the course plot that is currently displayed in the course buffer.
7. Select OK.

• • • Crash Analysis

What do you do if your landing was accidental? In other words, how do you analyze a crash? Nobody wants to crash, but it happens. Fortunately, Flight Simulator lets you learn from your mistakes and gives you several options for learning from these mistakes.

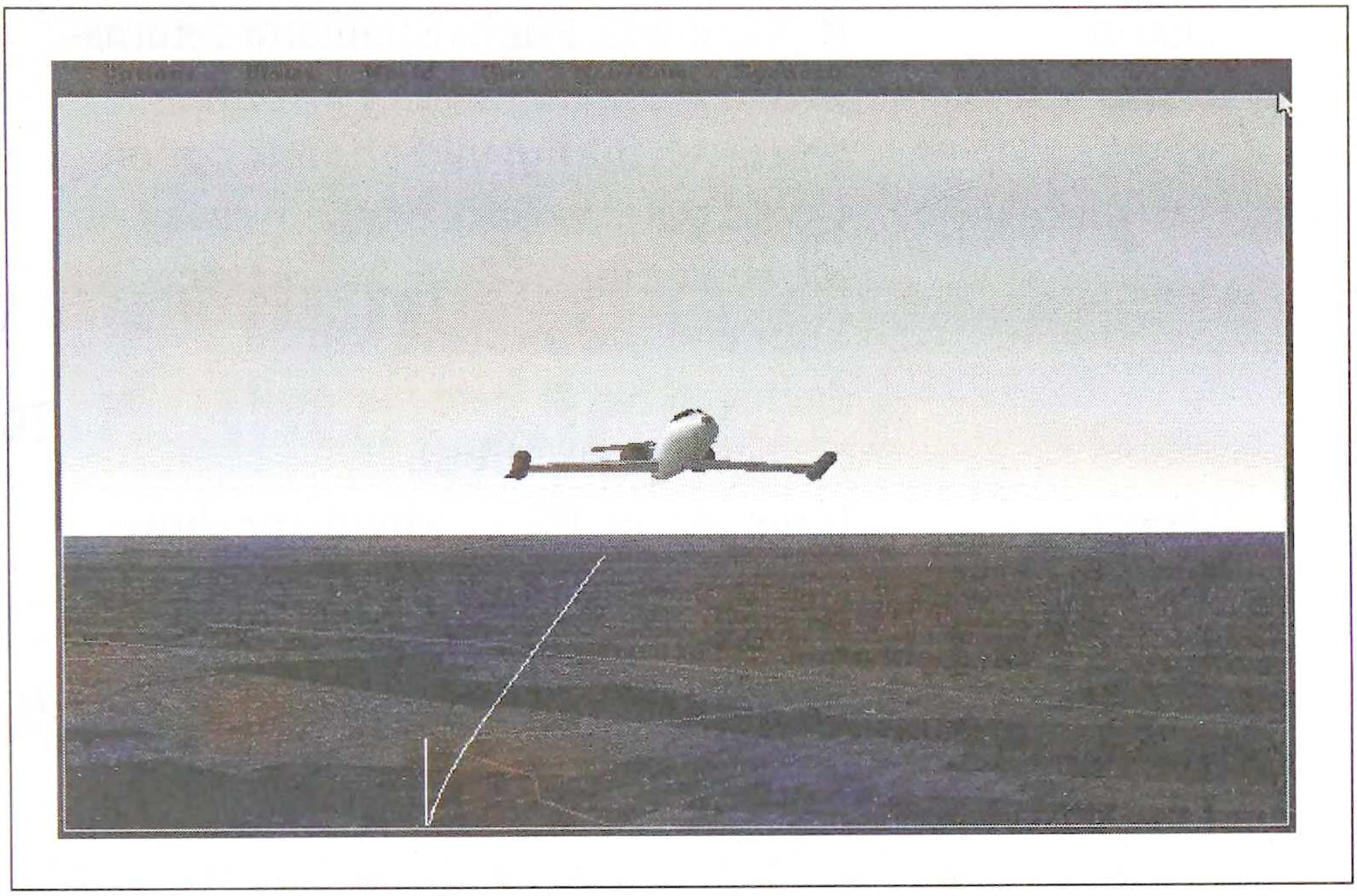


FIGURE 6.3: *A course tracking analysis graph for reviewing a course you have flown*

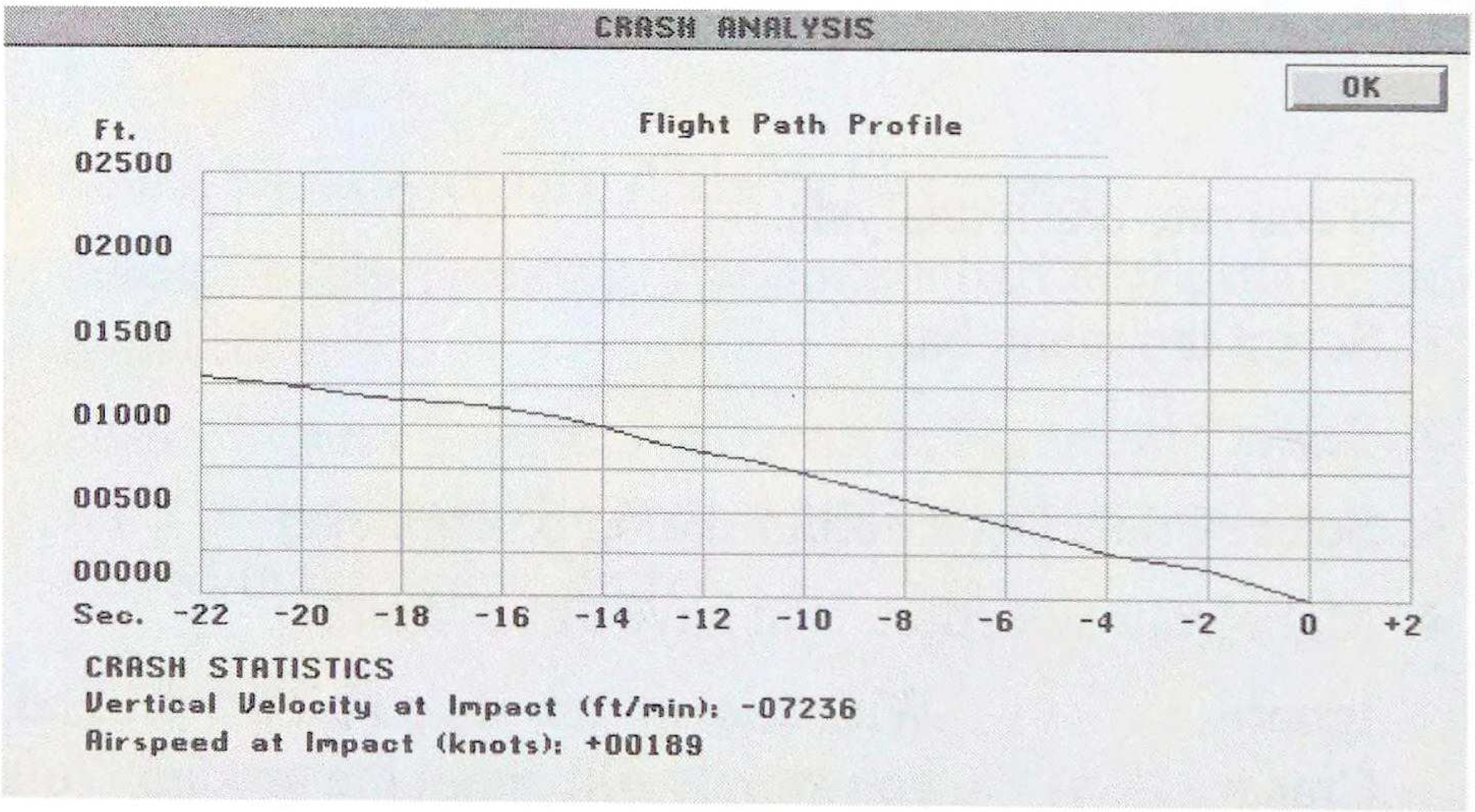
To activate crash analysis:

1. Select the menu bar.
2. Select Sim.
3. Select Crash Detection. A dialog box appears.
4. Make your selection. You have three choices:

Ignore Crash	With this option, if you hit the ground, you simply roll along the ground. Your airplane will have superhuman powers. You can crash into a building in a single bound and nothing will happen to you. You can take off again with no damage to the plane.

Detect Crash and Reset Situation	If you crash, Flight Simulator returns you to the situation. For example, if you crash during takeoff, this option would put you back on the runway at the beginning of the takeoff procedure. Your ego and airplane will be damaged but at least you will get the chance to start afresh.
Detect Crash and Show Graph	If you crash, Flight Simulator shows a graph of your flight path up until the point that you crash. Such a graph is shown in Figure 6.4.

5. Select OK.


CRASH ANALYSIS
OK
Flight Path Profile
Ft.
02500
02000
01500
01000
00500
00000
Sec.
-22
-20
-18
-16
-14
-12
-10
-8
-6
-4
-2
0
+2

CRASH STATISTICS
Vertical Velocity at Impact (ft/min): -07236
Airspeed at Impact (knots): +00189

FIGURE 6.4: *A crash analysis graph*

7

The Flight Simulator Air Force

With Flight Simulator, you can fly four airplanes—the Cessna, the Sailplane, the Learjet, and the Sopwith Camel. Moreover, if you install Aircraft and Scenery Designer (ASD) you can add three airplanes to Flight Simulator—the Cherokee Archer, the Beechcraft Starship, and the Boeing 747.

This step looks at each airplane. It describes their histories and vital statistics. It also mentions peculiarities about each one.

The Cessna

On a June day in 1911, a 31-year-old farmer-mechanic from Rago, Kansas named Clyde Cessna cranked up the engine of his homemade wood-and-fabric airplane and made his first short yet successful flight. He made history that day as the first person to build and fly an airplane west of the Mississippi River. Thereafter, until World War I put a damper on civilian flying, Clyde Cessna designed and built one airplane each year. He flew his inventions in exhibitions throughout the United States.

Each year he improved his basic design. Cessna never bothered to sell any of his airplanes. Barnstorming was more profitable, and surely more fun, than selling airplanes. Formal production of the Cessna began in 1916 when the inventor accepted an invitation from the Jones Motor Car Company to build his newest airplane in its plant in Wichita, Kansas. In 1927 the Cessna Aircraft Company was born. The company has created numerous families of airplanes over the years.

Cessna and Flight Simulator

The Cessna has a special place in Flight Simulator. Not only is the Cessna the default aircraft (unless you add Aircraft and Scenery Designer), it is also the airplane of choice for formation flying and crop dusting. The Skylane RG II, shown in Figure 7.1, has a service ceiling of 14,900 feet and a maximum climb rate of 1050 feet per minute. The *service ceiling* is the highest altitude to which an airplane can fly safely. You can cruise 7.5 hours at 133 knots (at 8000 feet).

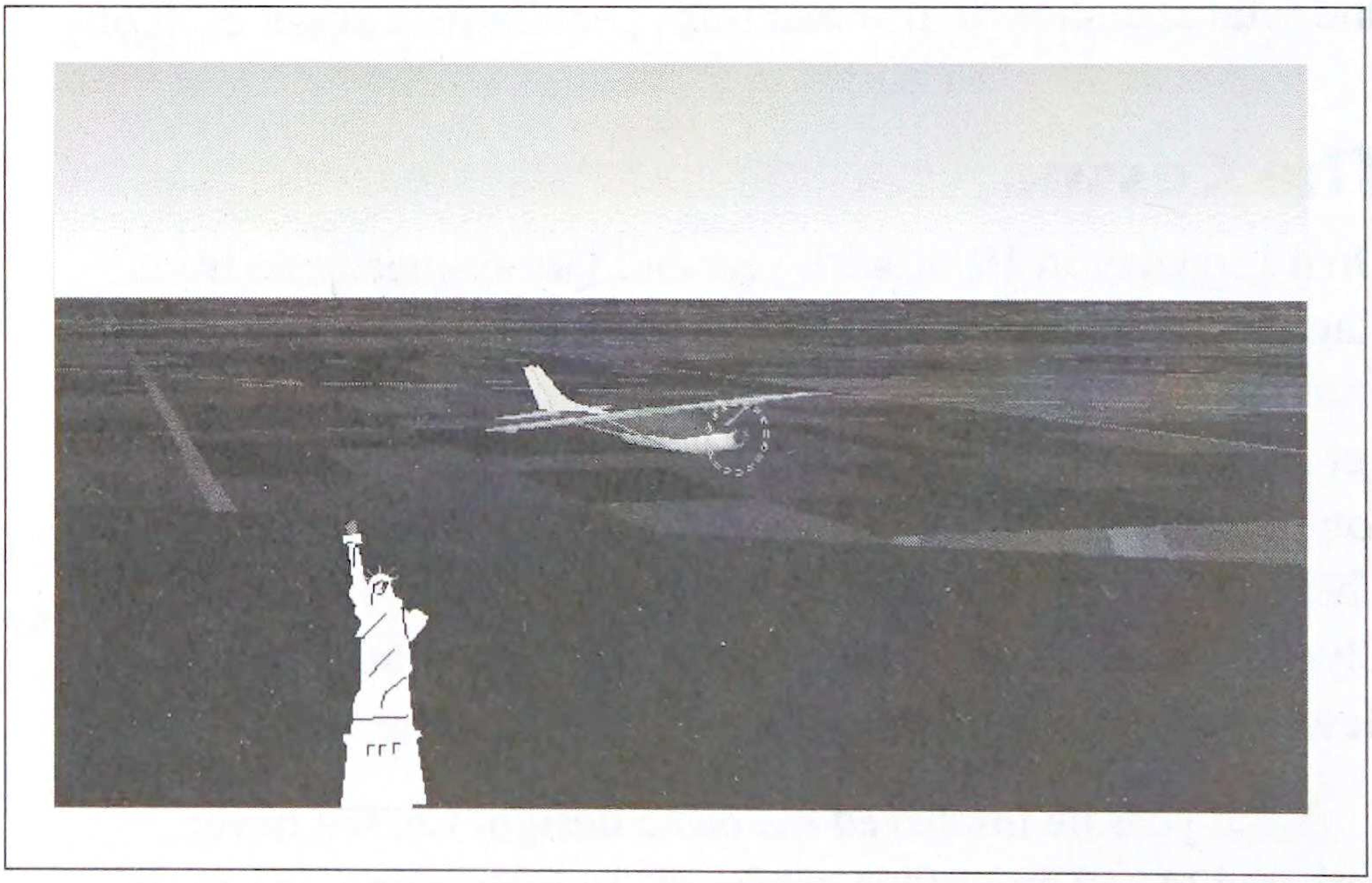


FIGURE 7.1: *The Cessna. This is Flight Simulator's default airplane.*

The Cessna is a stable airplane. It is a good airplane to learn how to fly in.

Following is a list of vital statistics about the Cessna. In this list, the *clean stall speed* is the speed at which the airplane stalls under normal flight configuration with the landing gear and flaps up. The *dirty stall speed* is the speed at which the airplane stalls with the landing gear and the flaps down. These speeds vary depending on how much fuel is in the plane, because fuel adds weight.

Length: 28 feet
Height: 9 feet 3 inches
Wing span: 35 feet 10 inches
Service ceiling: 14,300 feet
Maximum speed: 160 knots
Stall speed: 54 knots (clean), 40 knots (dirty)

The Sailplane

In 1890, thirteen years before the Wright Brothers flew their first airplane, Otto Lilienthal produced the first glider. Lilienthal's gliders, modeled after birds, were light and easy to maneuver. The frames and wings were made of light and flexible willow wands over which light cotton fabric was stretched. From 1891 to 1896, Lilienthal made over two thousand short trips in his gliders. Lilienthal died in a glider crash, and his last words are supposed to have been "sacrifices must be made."

Although Lilienthal's gliders are the ancestors of today's sailplanes (as well as the ancestors of all airplanes), they are more closely related to hang gliders. One step up from a hang glider is a primary glider. Primary gliders have open framework bodies. Their wings and tails are braced with wire. The pilot sits at the front of the glider in an open seat. Utility gliders have enclosed bodies and wings with strong lifting power.

The most advanced glider design, however, is the sailplane. A sailplane is also known as a soaring plane. Sailplanes can glide at very flat angles. Some lose only a foot of altitude for every 35 to 40 feet covered. In the jargon of gliders, they have low *sinking* speeds. The sinking speed refers to the rate of altitude drop over time. Some sailplanes drop at a rate of less than two feet per second, which is slower than a soap bubble drops through still air.

Flight Simulator offers a Schweizer 2-32 Sailplane. The aircraft, shown in Figure 7.2, is recommended for pilots who want to hone their skills. Its cockpit is shown in Figure 7.3.

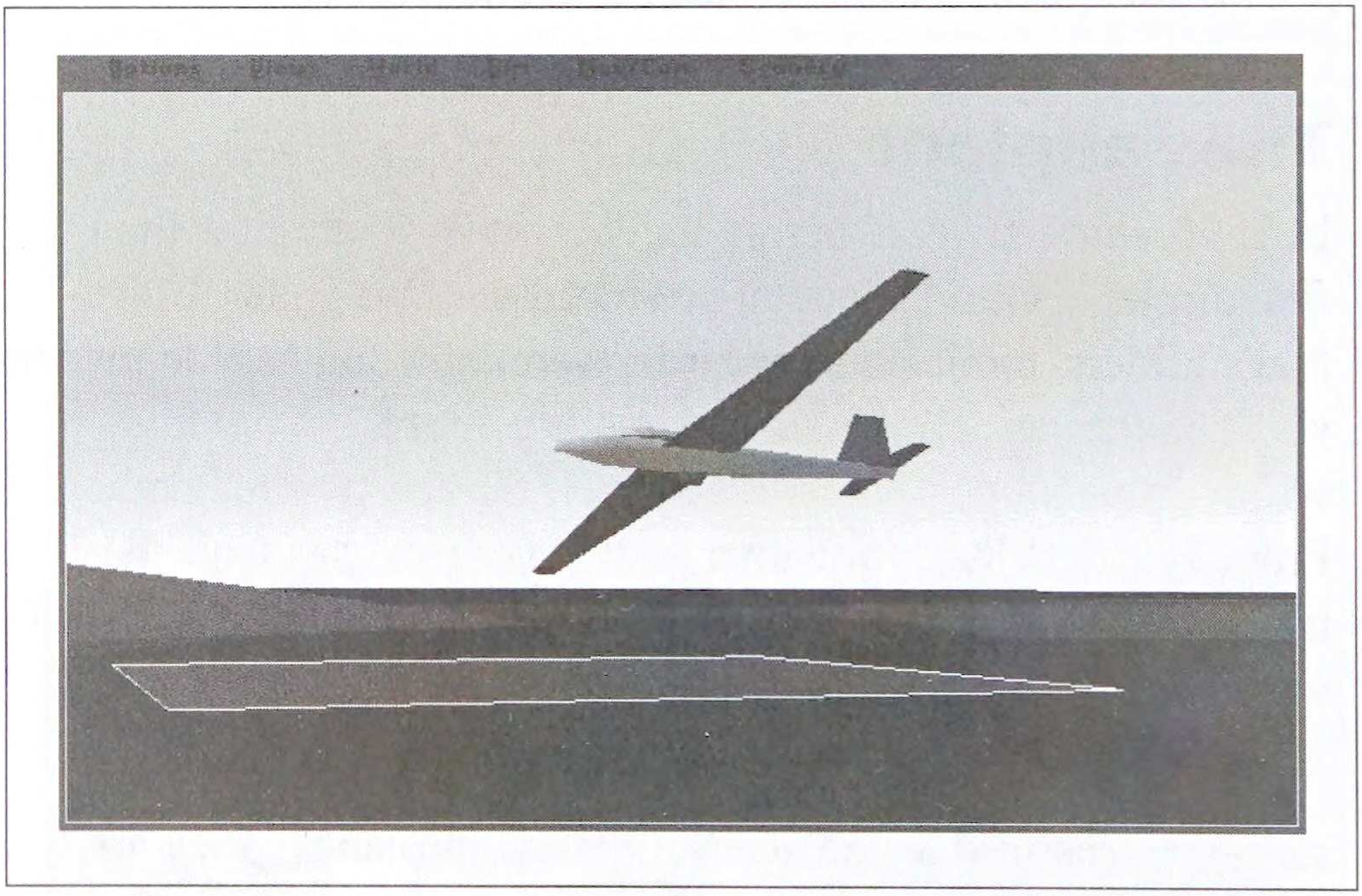


FIGURE 7.2: *A Schweizer 2-32 Sailplane as it appears in Flight Simulator*

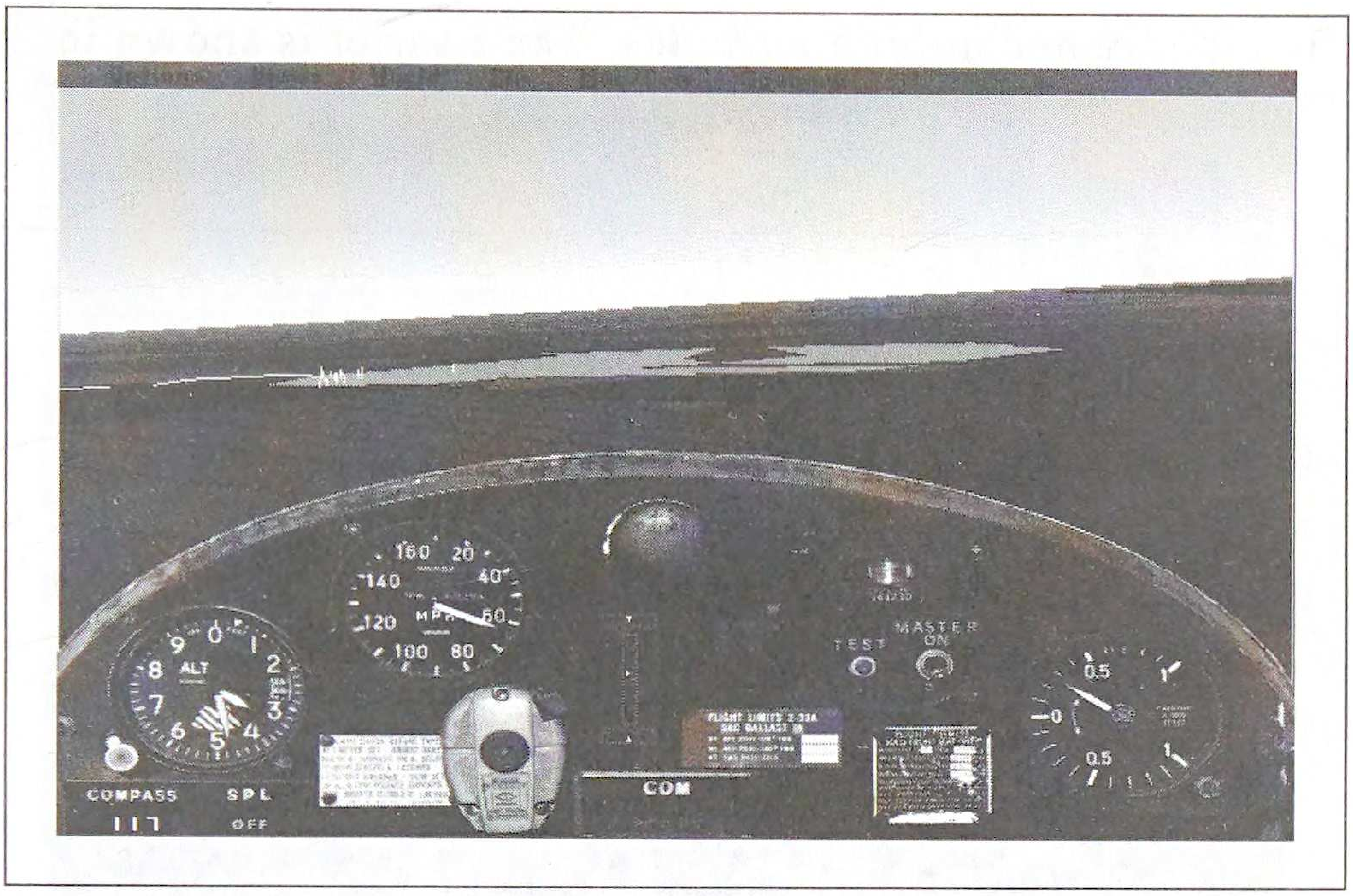

160
20
140
40
120
MPH
60
100
80
ALT
COMPASS
SPL
OFF
TEST
MASTER
ON
COM
FLIGHT LIMITS 2-33A
0.5
0

FIGURE 7.3: *View from the sailplane's cockpit*

The Sailplane's vital statistics are as follows:

Length: 26 feet 9 inches

Height: 9 feet

Wing span: 57 feet

Wing area: 180 square feet

Gross weight: 1340 pounds

Empty weight: 831 pounds

Stall speed; 48 knots

Minimum sink (solo): 2 feet per second at 40 knots

The Learjet

The performance characteristics of a Flight Simulator Learjet closely resemble those of a Learjet 25G twin turbojet. You can fly quickly and at high altitudes. The Learjet is shown in Figure 7.4. Its cockpit is shown in Figure 7.5.

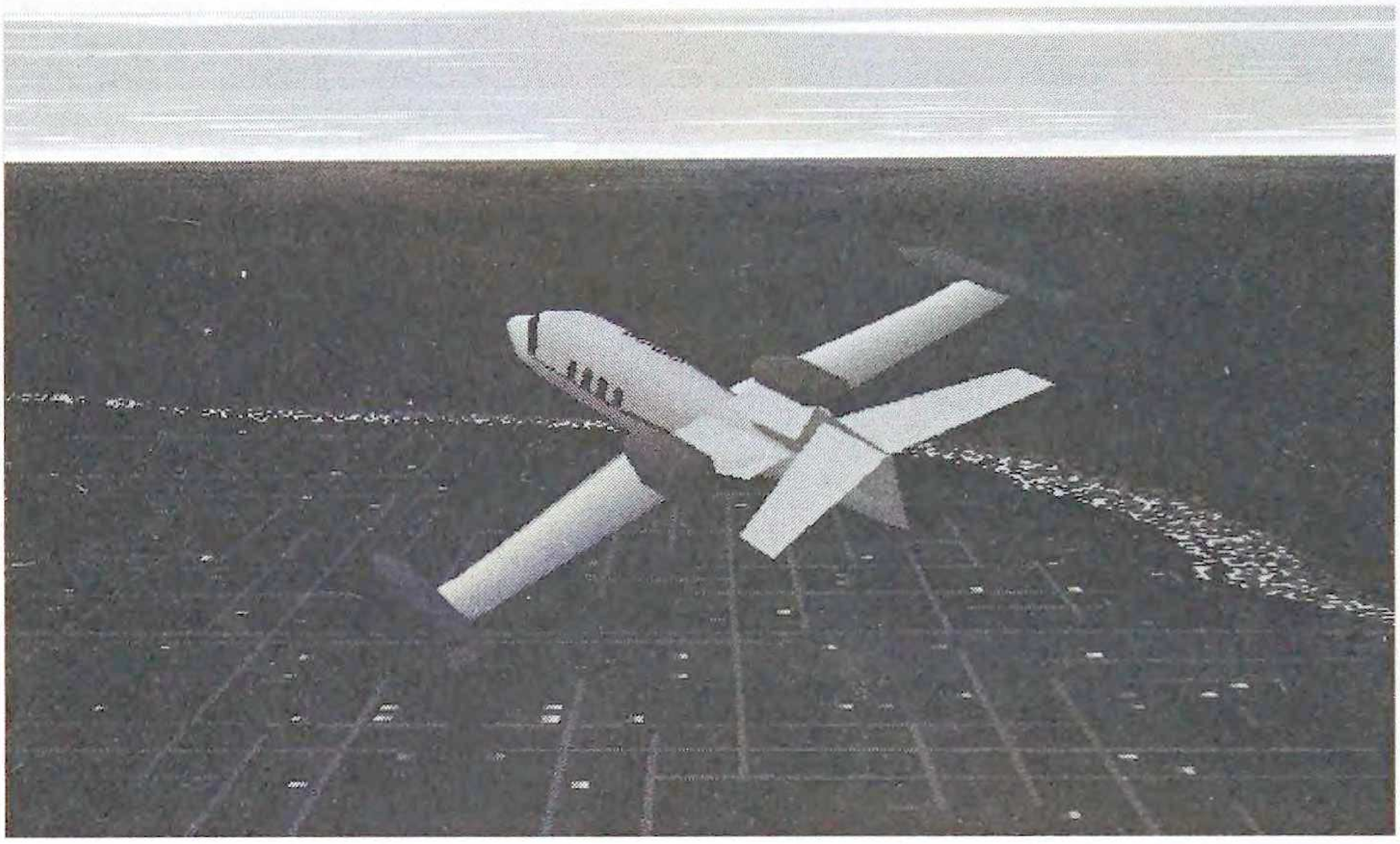


FIGURE 7.4: *The Learjet*

Most of the instruments for the Learjet simulation are the same as the instruments for the single-engine prop aircraft simulation. In the real world, however, Learjets have twice as many engines and instruments as single-engine propeller airplanes. In the past, Flight Simulator used the single prop configuration for both. Version 5, however, offers dual instruments and controls, including:

- dual throttle controls
- two turbine temperature gauges
- two pointers on the oil temperature gauge
- two pointers on the oil pressure gauge

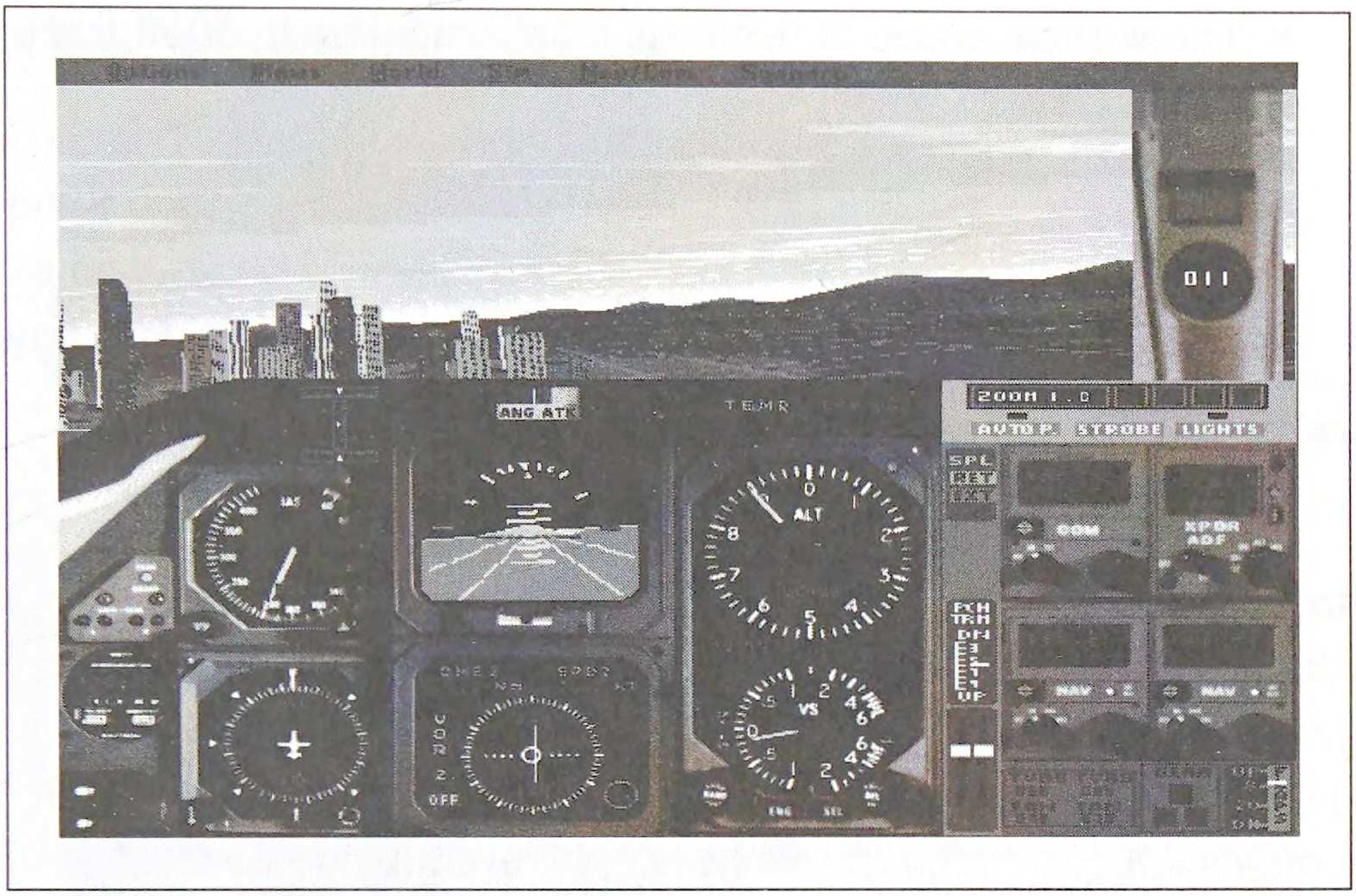

World
Sim
ANG ATK
ZOOM 1.0
AUTO P.
STROBE
LIGHTS
SPL
RET
EXT
ALT
VS
COM
XPDR
ADF
NAV 1
NAV 2
TRM
OFF
ENG
SEL

FIGURE 7.5: *The control panel of the Learjet*

Differences between Learjet and Cessna Instruments

There are also several key differences between Cessna and Learjet instruments:

- The Learjet has a tachometer recalibrated to show percentage of full RPM instead of absolute RPM.
- The Learjet has an airspeed indicator recalibrated to read speeds up to the speed of sound, Mach I (740 mph at sea level).
- The Learjet has an airspeed indicator showing the true rather than the indicated speed, which is based on airflow.
- The carb heat reading changes to a spoilers reading.
- The Mags reading changes to the Engs reading.

- The vertical speed indicator is recalibrated up to 6000 feet per minute.
- The engine switch replaces the magnetos switch.

TIP ***The instruments in the Learjet also have a different feel. The throttle moves a little more slowly and the aileron and rudder sensitivity is slightly higher.***

When flying the Learjet, remember to fly it with a light touch, making slow, steady control movements. However, you shouldn't expect it to respond as quickly as a small plane. The jet is heavy. A Learjet 25G has a maximum takeoff weight of 18,300 pounds as compared to a Cessna Skylane RG 11's 3100 pounds. Once an aircraft this heavy is committed to a given course and speed, you will need extra effort to slow it down or change its flight direction.

Mach is the speed of sound. For most jet aircraft, speed is measured in Mach. The speed of sound varies, depending on altitude and how thick the atmosphere is.

Following are the vital statistics about the Learjet:

Length: 48 feet 8 inches
Height: 12 feet 3 inches
Wing span: 39 feet 6 inches
Service ceiling: 41,000 feet
Maximum take off weight: 18,300 pounds
Maximum speed: 0.81 Mach
Stall speed: 96 knots (dirty)

WARNING ***Don't exceed the maximum operating speed of 0.81 Mach.***

The Sopwith Camel

Unlike Version 4, Version 5 does not have a World War I area, but it does have a Sopwith Camel. That is good news if you are an historical airplane buff. Figure 7.6 shows a Sopwith Camel, and Figure 7.7 shows its cockpit.

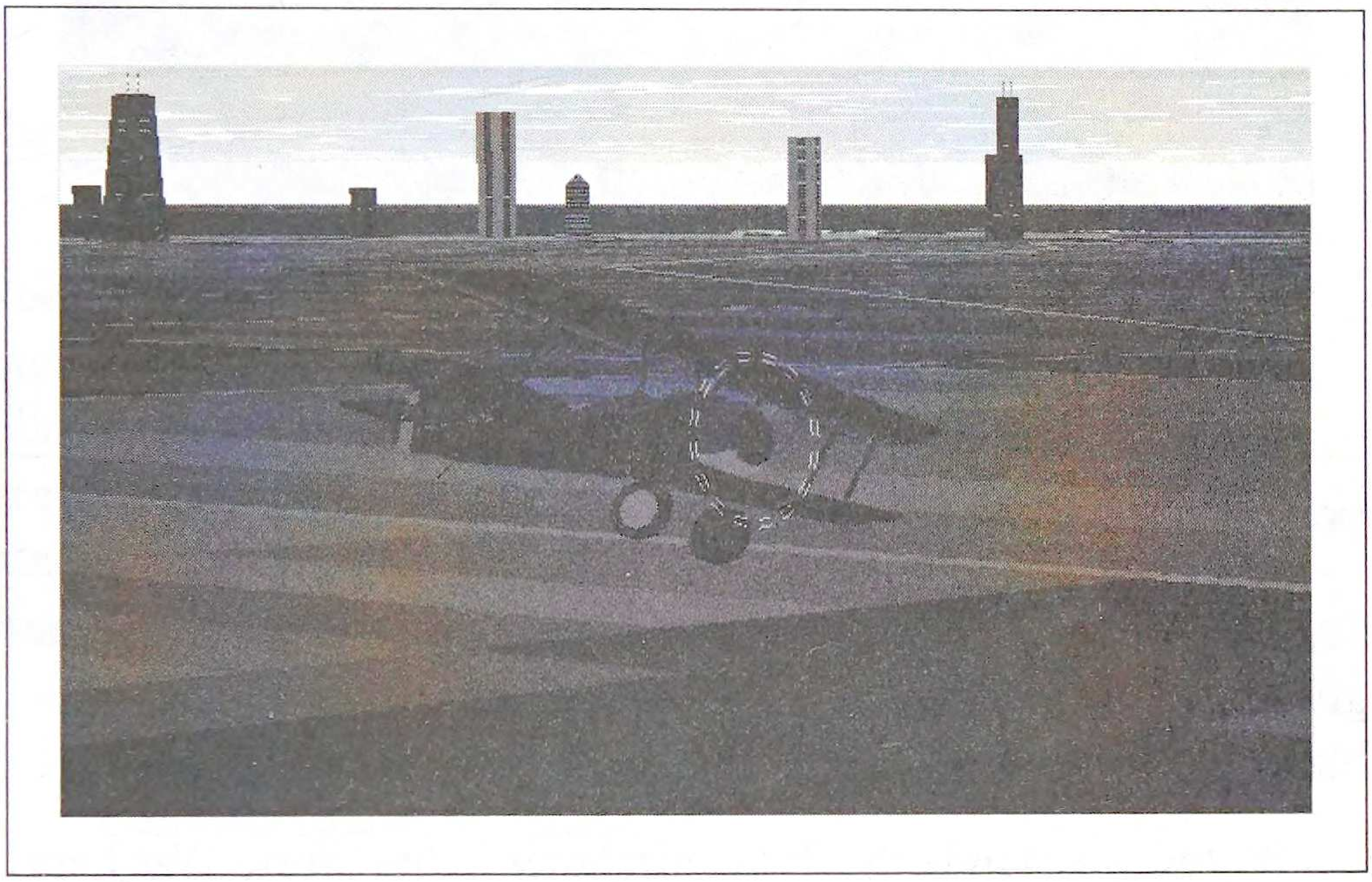


FIGURE 7.6: *A Sopwith Camel*

Sir Thomas Octave Murdoch Sopwith was the father of the Sopwith Camel. Sopwith taught himself to fly in 1910 and that year won the Forest Prize for the longest flight on the European continent. In 1912, he founded the Sopwith Aviation Company, Ltd. and won the first aerial derby in his Bleriot monoplane.

During World War I, Sopwith's company produced many military aircraft. His most famous models included the Pup,

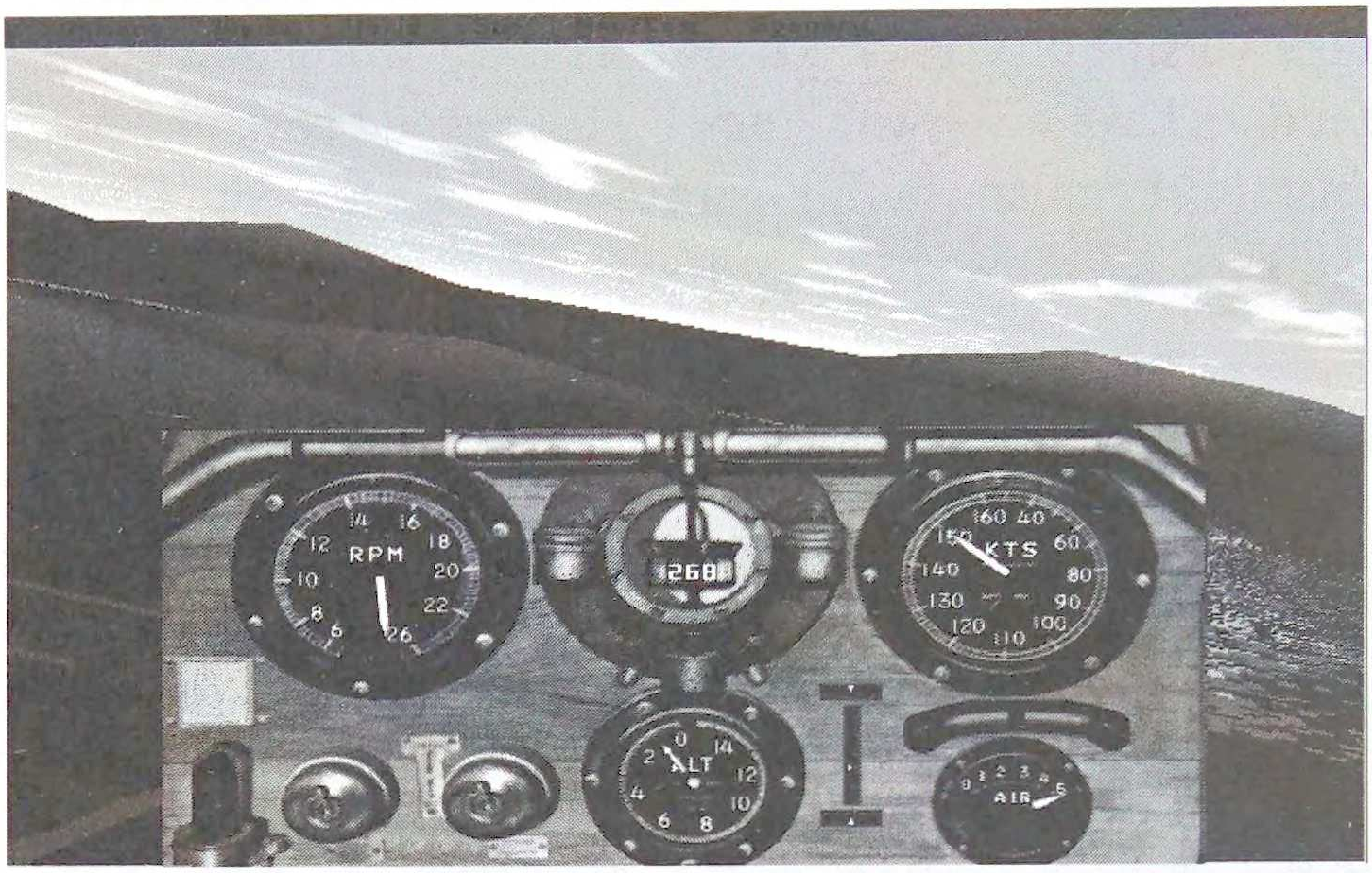


FIGURE 7.7: *The cockpit of the Sopwith Camel*

Triplane, and 1½ Strutter, as well as the Camel. The Camel was given its name because of its unusual shape. The cockpit resembles a hump.

By today's standards, flying airplanes in the World War I era was anything but fun. Pilots sitting in the open cockpit of Sopwith Camels could feel the cold rush of wind as they flew. Sometimes, they would fly as high as 21,000 feet, where air was extra cold and thin. On a Sopwith Camel, the rotary engine throws oil everywhere, including the pilot's face. Did you ever wonder why pilots wore scarves? They wore them to clean off their goggles. Pilots were constantly exposed to the fumes from the engine. Often they grew sick or dizzy from the fumes.

The British produced 5,490 Sopwith Camels during the war. They were considered the most successful airplane of the war. All in all, Camels shot down 1,294 enemy airplanes. While the twin Vickers .303-caliber machine guns were highly effective, they had to be pointed directly at the enemy to shoot anyone down. Camels were difficult to fly and caused numerous accidents.

Perhaps the most famous Camel pilot of all was a Canadian named Roy Brown. Brown is usually credited with shooting down Manfred von Richtofen, the Red Baron.

Sopwith also produced airplanes in World War II, including the Hurricane fighter and the Lancaster bomber.

Do not look for a machine gun on the Version 5 Camel—it does not have one. But the kinder, gentler new Camel is still quite a sight to behold. The old Cessna dashboard has been replaced with an authentic looking wooden and brass one. There are three primary instruments: the compass in the middle, the airspeed indicator on the right, and an RPM indicator on the left (see Figure 7.7).

Following are the Sopwith Camel's vital statistics:

Length: 18 feet 9 inches
Height: 9 feet
Wing span: 28 feet
Service ceiling: 19,000 feet
Gross weight: 1482 pounds
Empty weight: 950 pounds
Stall speed: 50 knots

. . . ASD Airplanes

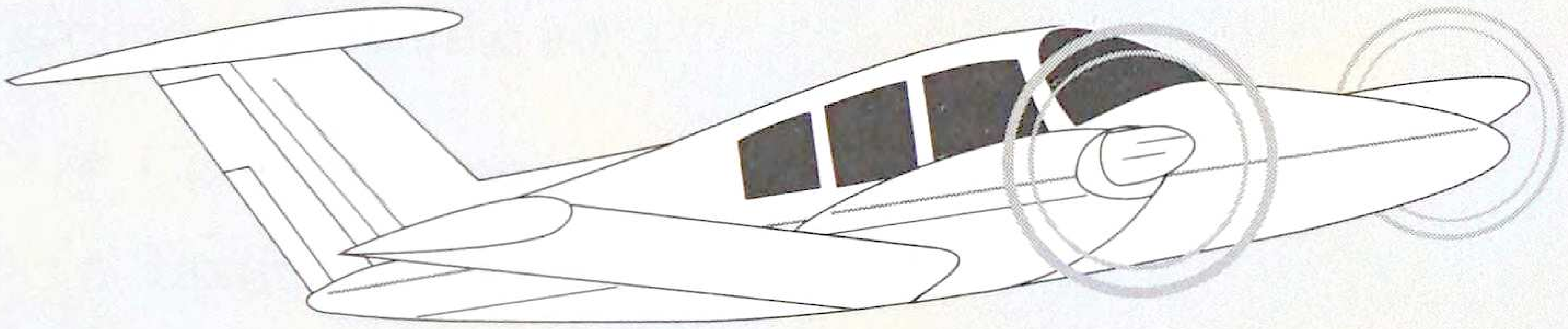
If you install Aircraft and Scenery Designer you can add three airplanes to Flight Simulator: the Piper Cherokee Archer, the Beechcraft Startup, and the Boeing 747.

WARNING ***Microsoft has announced the creation of a new ASD product that is compatible with Version 5. Meanwhile, efforts are underway to make old ASD files compatible with Version 5.***

The Piper Cherokee Archer is in the same basic class as the Cessna Skylane RGII. The 747 is very familiar to anyone who has ever flown in a commercial flight. You don't have to think of a 747 as a commercial carrier. Many of the social and corporate elite these days use 747s as private jets.

PART TWO

• • • FLYING



8

Getting Ready to Take Off

One advantage of Flight Simulator over real airplanes is that you can take off right away without the usual—and necessary—preflight steps. However, if you want to make your flights as realistic as possible, you need to prepare to take off. This chapter takes you through the four stages of getting an airplane off the ground and into the air:

- Checking your instruments
- Taxiing to the runway
- Communicating with Air Traffic Control
- The takeoff

This step also explains how to change airplanes in case you decide not to fly Flight Simulator's default airplane, the Cessna.

Selecting a New Airplane

If you prefer to fly another airplane, such as the Learjet:

1. Select Options.
2. Select Aircraft. A dialog box appears for selecting a new airplane.

3. Select the airplane you want.
4. Select OK.

A bemused FS 5.0 pilot once compared choosing an airplane this way to “picking an airplane out of your closet.”

. . . Checking Your Instruments

TIP ***Whenever you climb into a new airplane—whether a real one or a Flight Simulator airplane—take a moment to look around and see what the view from the cockpit windows look like. That way you will better orient yourself on the ground during the taxiing procedure.***

The first thing you will see when you start your airplane is Chicago’s Meigs Field runway 36 stretching in front of you into the horizon, as shown in Figure 8.1. Take a moment to check out the view from the cockpit on all sides. How to change views is described in Table 8.1.

PRESS	TO VIEW
Shift+2	Directly in back
Shift+3	Behind the right wing
Shift+6	The right wing tip
Shift+9	The immediate right
Shift+1	The left wing tip
Shift+4	Behind the left wing tip
Shift+7	The immediate left
Shift+8	Directly in front

TABLE 8.1: *Flight Simulator Cockpit Views*

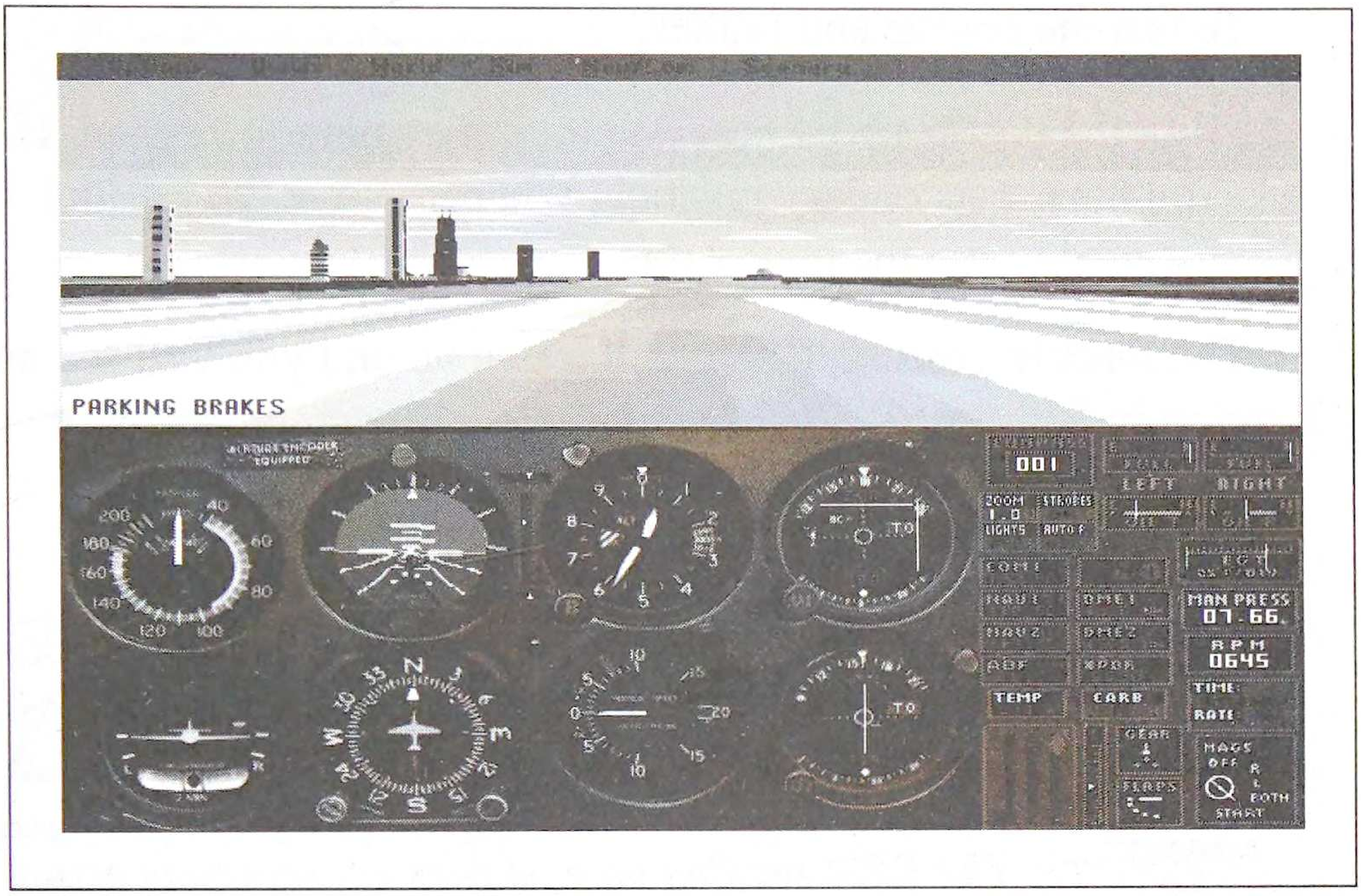

PARKING BRAKES
001
LEFT
RIGHT
ZOOM
1.0
STROBES
LIGHTS
AUTO P
COM
NAV1
NAV2
DME1
DME2
ADF
XPDR
MAN PRESS
07.66
RPM
0645
TIME
RATE
TEMP
CARB
GEAR
FLAPS
MAGS
OFF
R
L
BOTH
START
TO

FIGURE 8.1: *Runway 36 of Chicago's Meigs field*

Checking the Airport Map

Next, you will want to check your airport map. To do this:

1. Select the menu bar.
2. Select View.
3. Select Map View.
4. Press the plus key (+) to zoom in and out.
5. Press NumLock twice to turn the map window off.

Testing Flight Controls and Instruments

Before you take off, you should check the following items:

- Engines and brakes
- Flaps
- Flight controls

To test the engine and brakes:

1. Run the power up by pressing 9 on the numeric keypad. If you have a secondary joystick, you can move the joystick forward to run the power up.

The throttle position gauge will move up and you will see an increase in RPM on the RPM gauge.

2. When you start to move forward, pull the power back to idle. Press 3 on the numeric pad until the throttle position indicator is at the bottom of the scale. You can also do this by moving the joystick backward until the throttle position is at the bottom of the scale.

NOTE ***The RPM reading on a jet does not represent actual revolutions per minute as it does on a reciprocating engine aircraft. Instead, RPM on jet engines represents a percentage of total RPM.***

To test the flaps:

- Lower the flaps one notch by pressing F6. The flap indicator should show the flaps lowered one notch.

Now test the ailerons, elevators, and rudder. To move the ailerons:

- Press the ← and → keys, or move the joystick from side to side. The aileron position indicator will move in response to your control movement.

NOTE ***The rudder position indicator will move when you move the ailerons. That is because Flight Simulator is defaulted to auto-coordinated mode.***

To move the elevators:

- Press the ↑ and ↓ keys, or move the joystick forward and backward.

To move the rudder:

- Press the numeric pad 0 for left yaw. For right yaw, press the bottom-right key on the numeric keypad (either the plus key or Enter). You can also move the joystick to the right or the left to test the left and right yaw.

ACTION ***When you have finished checking the instruments, center the rudder by pressing 5 on the numeric keypad or by centering the joystick.***

Taxiing to the Runway

For beginners, taxiing can be a difficult process. It involves both acceleration and deceleration. Aircraft engines have fairly high idles. A lightly loaded plane requires very little power to start it rolling to the runway. Figure 8.2 shows an airplane taxiing to the runway.

Unlike a car, when you take your foot off the gas, an airplane does not slow down immediately. Nor can you ride an airplane's brakes the way you can a car's. Riding the brakes on an airplane can make them get hot and be less effective in case you have to make an emergency stop. In the real world, pilots taxi by applying the brakes until the aircraft is traveling very slowly, then releasing the brakes, then letting the plane accelerate again.

TIP ***If you need practice with taxiing, you might want to select the lesson provided by Flight Simulator.***

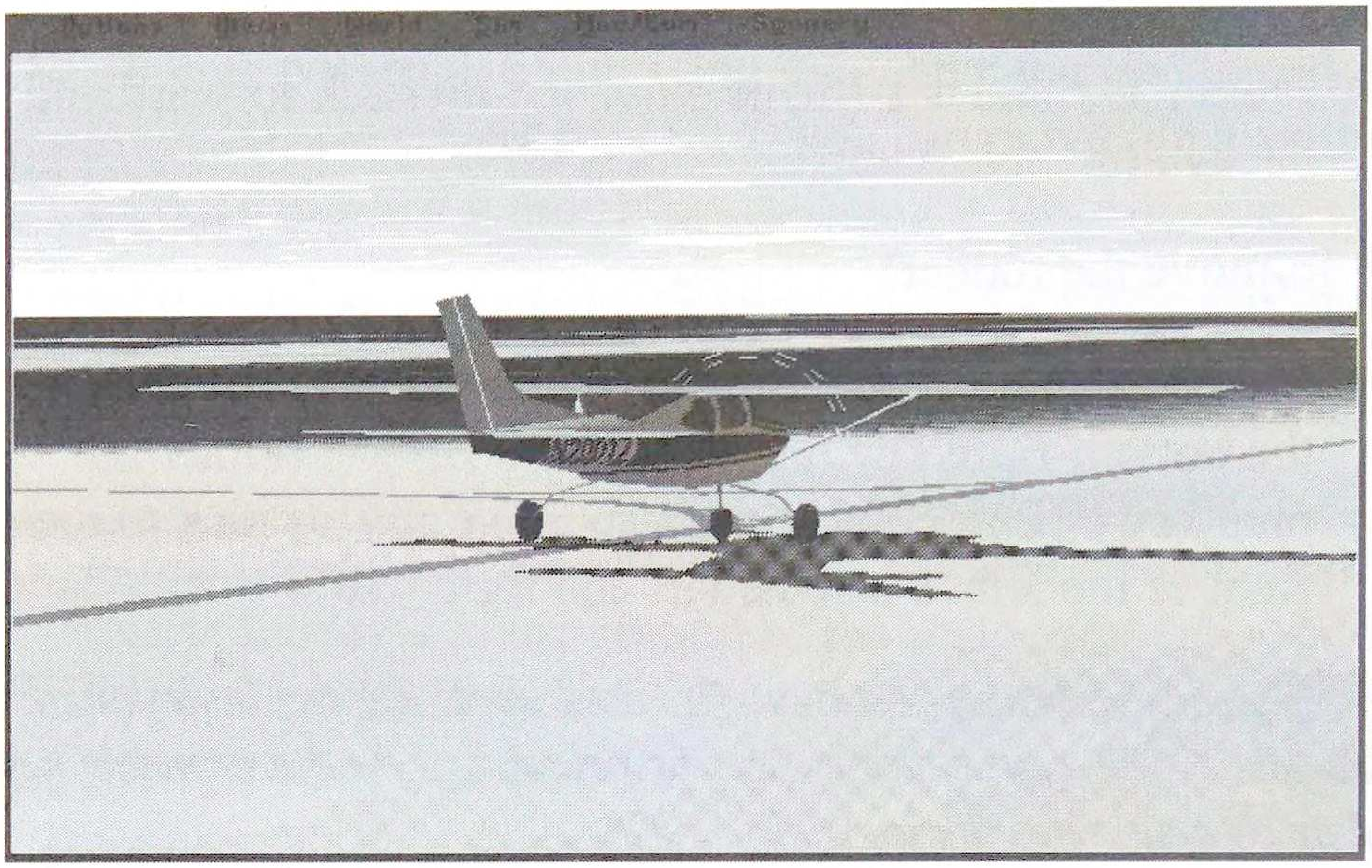


FIGURE 8.2: *Taxiing to the runway*

If you need practice taxiing, take the taxiing lesson provided by Flight Simulator:

1. Select the menu bar.
2. Select Options.
3. Select Flight Instruction.
4. Select Lesson 1, Taxiing.
5. Select OK.
6. Select OK again when the lesson is over.

TIP ***Always align your airplane with the center line when you are taxiing.***

• • • Communicating with ATC

In Flight Simulator, you do not need the tower's permission to take off, but if you were operating a real aircraft you would need it. The tower clears airplanes for take off and sends them over to departure control frequency. Pilots, during takeoff, are in close contact with Air Traffic Control. They are in constant communication with the tower and its computer facilities.

When an airplane is on the ground, and when it is below the10,000 feet level, the *Sterile Cockpit Rule* applies. This rule, set by the Federal Aviation Administration, forbids communication between the pilot and control tower except in matters relating to the takeoff and landing of the plane. The Sterile Cockpit Rule is intended to reduce the pilot's workload during the busiest and most crucial parts of the flight.

ACTION ***Be sure to tune in the ATIS (automatic technical information service) on your COM radio. ATIS provides airport, weather, and approach information.***

ATC ground computers follow all flights. Once the airplane's four-digit code is entered in the on-board transponder, the flight can be tracked by the ATC. As the coded blip passes across the traffic controller's radar scope, he or she can see both the airplane's current position and its anticipated location in any time frame. The current direction, speed, and rate of altitude change are all displayed. They are updated every few seconds.

Twenty separate Air Traffic Control centers are located throughout the continental United States. Each center is divided into multiple sectors with different radio frequencies. Pilots talk with one portion of an ATC center at any given time, but the radar blip that represents their airplanes can be seen on multiple radar scopes simultaneously.

Traffic Separation

One of the chief responsibilities of the ATC is *traffic separation.* In good weather, all aircraft within the terminal radar area are kept to a minimum of three miles apart. In bad weather, the distance is even greater. When an airplane leaves the airport vicinity, however, the minimum separation distance increases to five miles. At higher altitudes, aircraft are kept to a distance of ten to twenty miles from one another to prevent collisions.

When ATC computers detect two airplanes getting closer than the prescribed minimum distance, they give out an alert. A flashing light appears and a beep is heard. At this time, air traffic controllers immediately alert one or both airplanes and direct them to separate paths.

The ATC and Commercial Airlines

At very large airports, commercial airplanes must obtain ramp control clearance before they can begin taxiing to the runway. Larger airports have ground radar systems that "see" airplanes on the ground. After leaving the ramp area, ATC ground control has jurisdiction. On the other hand, at smaller airports, the ground controller located in the airport tower has sole responsibility for taxiing airplanes.

At airports with many runways, Air Traffic Control uses the general direction of an airplane's destination to determine which runway to assign. At Miami International, for example, planes traveling to South America are assigned the south runway, and north-bound and northwest-bound planes destined for Chicago or Boston use the north runway.

• • The Takeoff

ACTION *When you are ready to begin take off, increase the power by pressing and holding down the 9 on the numeric keypad until the throttle position indicator is pegged at the top of the gauge. You can also do this by moving your joystick forward.*

The aircraft will start to accelerate smoothly down the runway. You can move the joystick to the right or left, or press the 0 and bottom-right keys on the numeric keypad, to keep the aircraft moving down the middle of the runway.

To begin takeoff:

1. When the aircraft reaches the following rotation speeds:

    - 120 IAS (indicated air speed) for a Learjet
    - 80 knots for a Cessna

    rotate the aircraft to 10 degrees nose high by pulling back on the joystick or pressing 2 on the numeric keypad. At this point, your airplane should be in a position similar to the one in Figure 8.3.

2. Once you can see the altimeter increasing and you are certain that you are in the air, retract the landing gear and flaps:

    - Press G for the landing gear.
    - Press F5 for the flaps.

3. Check the cockpit displays to confirm that the landing gear and flaps are up.

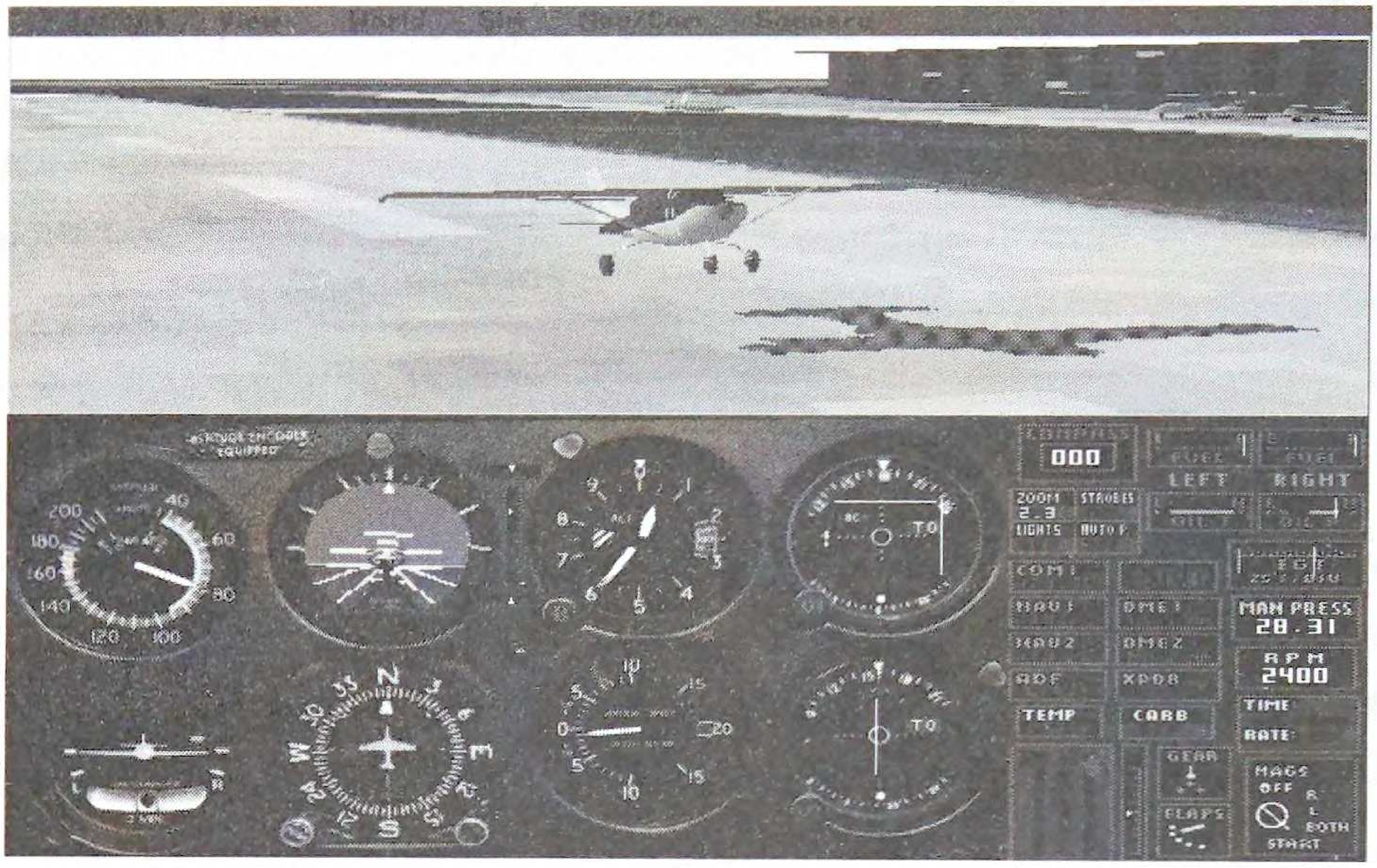

COMPASS
000
ZOOM 2.3
STROBES
LIGHTS
AUTO P
FUEL LEFT
FUEL RIGHT
COM 1
NAV 1
NAV 2
ADF
DME 1
DME 2
XPDR
TEMP
CARB
MAN PRESS
28.31
RPM
2400
TIME
RATE
GEAR
FLAPS
MAGS
OFF
R
L
BOTH
START
N
E
S
W
TO

FIGURE 8.3: *The takeoff*

4. You may want to stop and admire you work at this point. To do so, press P to pause the flight after you have raised the landing gear and flaps.

WARNING ***Be sure to pay attention to pitch. Avoid letting the pitch get too high and airspeed get too low. This can result in a stall.***

Crosswind Takeoff

Compensating for the wind is important in air traffic control. The more advanced your piloting skills become, the more able you will be to compensate for the wind in takeoffs, landings, and actual flights. To perform a crosswind takeoff:

1. Move down the runway, applying the right aileron into the right crosswind (the wind blowing across the runway from right to left).

2. Once you lift off, apply the ailerons and rudder into the wind until you have turned enough that your *crab angle*—also known as the *correction angle*—is lined up with the runway.
3. Level your wings and keep on a straight course, aligned with the runway.

9

Climbing

Climbing refers to the time between take off and before you reach cruising altitude. Climbing involves three separate phases:

- Entry
- The climb itself
- Leveling off

This step describes all three phases and tells you how to negotiate them.

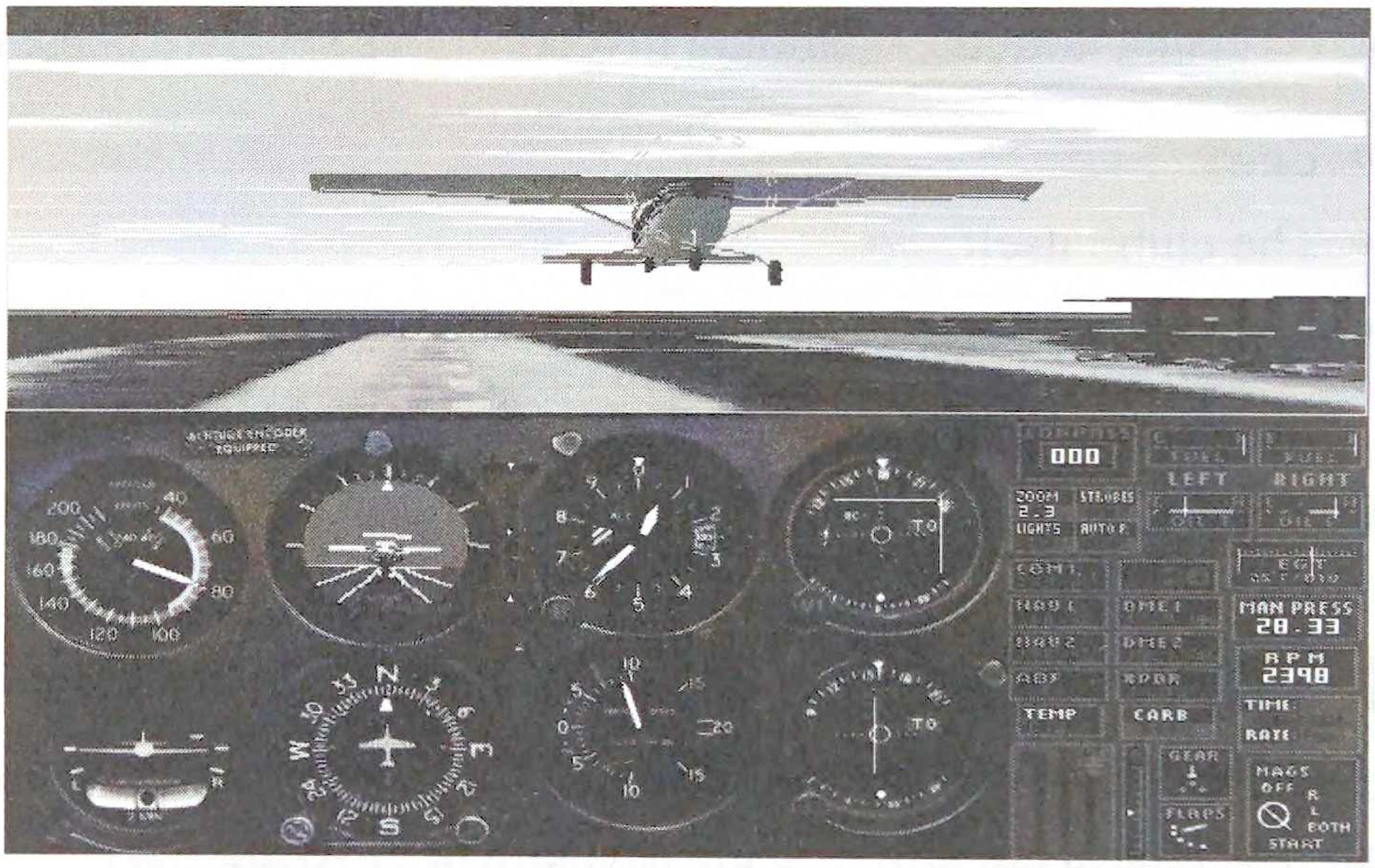
The Entry Phase

Entry, when the airplane's landing gear leaves the ground and the nose first inches up, is where the excitement of flying truly starts. This is when you experience the thrill of actually getting your airplane in the air. The entry phase, however, is short. Once you have taken off, you have to begin focusing on the climb ahead.

The vertical speed indicator is the primary pitch instrument for a constant-rate climb. For a constant-rate climb, adjust the airplane's pitch to establish the rate of climb and adjust the throttle setting to maintain the vertical airspeed you desire.

The Climbing Phase

Use the throttle to achieve a constant-rate climb of about 900 feet per minute (FPM) for the Cessna. At this rate, the vertical velocity indicator will level off at about 900 FPM and the selected airspeed will be about 70 knots. Figure 9.1 shows the climbing phase.


000
LEFT
RIGHT
ZOOM
2.3
STROBES
LIGHTS
AUTO P.
COM1
NAV1
NAV2
DME1
DME2
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TEMP
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2398
TIME
RATE
GEAR
FLAPS
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L
BOTH
START
TO

FIGURE 9.1: *The climbing phase*

The maximum rate of climb for the Cessna at sea level is 1050 FPM. An optimal level right after takeoff would be 900 FPM. You know that you are going this speed when you see the vertical speed indicator move to 9.

You may need to correct both the pitch and power setting to keep climbing at the same rate and with the same airspeed. On the other hand, if you wanted to climb at a constant airspeed, the pitch indicator—also called the artificial horizon—would be the primary pitch instrument.

ACTION ***To adjust the pitch of your airplane, use the ailerons. Also, use your ailerons to stabilize your plane if you encounter turbulence. Change your throttle and elevators to accommodate the steady decrease in lift as you gain altitude.***

Watch the pointer on the vertical elevator trim display. This pointer should be centered. You can fine-tune the elevator trim by pressing 7 to trim the aircraft nose down and press 1 to trim the aircraft nose up.

Making Pitch Corrections

The attitude indicator is trimmed to indicate a level flight and at 0 pitch at a specific AOA (angle of attack). When this happens, the arrow will point to 0. This angle of attack is influenced by airspeed. If you are going slower or faster than this airspeed, setting the attitude indicator to 0 will not produce a level flight. The flight will be close to level but not exactly so. For this reason, cross-check your altimeter and attitude indicator after setting a specific attitude, and if this does not produce the level flight you want, make a pitch correction.

ACTION ***With a low speed, high rate of climb, and full throttle, the aircraft may inadvertently turn left. When this happens, you should correct this mistake by moving the rudder right, either with your joystick or by pressing plus (+) or the Enter key, whichever is on the bottom-right of the numeric keypad.***

WARNING ***If your speed is too low and your rate of climb too high, you will not have sufficient lift to make your climb and your airplane might stall. A stall is shown in Figure 9.2. If you are in danger of stalling, Flight Simulator will give you warning. You will hear a beep and a stall indicator message will appear on the right side of the cockpit windshield. Do not panic and make any sudden changes in this situation. Simply lower the nose down and return to a straight path.***

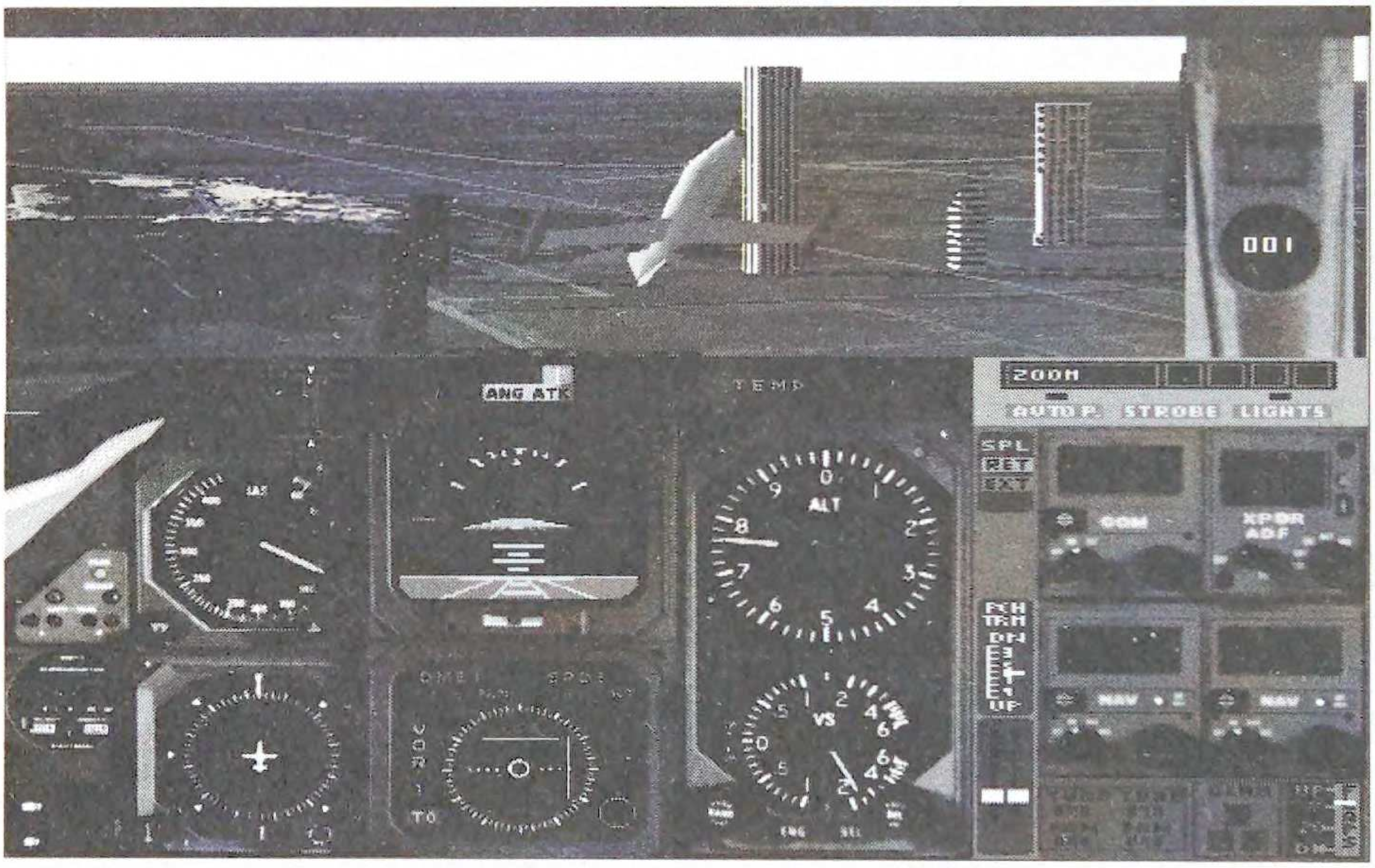


FIGURE 9.2: *A stalling airplane.*

Climbing Altitudes

Up until 10,000 feet, the ATC limits all aircraft to speeds below 250 knots. This restriction, of course, primarily applies to jets. Prop planes travel at much lower speeds to begin with.

After hitting the 10,000 foot limit, jet pilots accelerate to 300 to 320 knots. They lower the pitch from 10 degrees to a more level 5 degrees.

Although airplanes can climb from take off to their initial cruising altitude without leveling off, air traffic controllers discourage this. Sometimes, due to conflicting traffic and delayed radar hand-offs from one ATC facility to another, climbing directly to cruising altitude can be dangerous. Therefore, pilots usually climb in a series of "steps" until they reach cruising altitude.

Leveling Off

Leveling off requires you to bring the nose of the aircraft down. A good rule of thumb for calculating when to perform a level-off is to take 10 percent of the vertical speed indicator and subtract this number (if you are climbing) or add it (if you are descending) to your targeted level of altitude.

For example, if you are climbing at 1000 feet per minute according to the vertical speed indicator and you want to level off at 3000 feet, start leveling off when the altimeter reads 2800 feet. On the other hand, if you are descending to 3000 feet per minute, start to level off at 3100 feet.

You will be flying a straight and level path when an equilibrium is reached between the elevator position and the throttle setting.

You know you are flying straight and level when the horizon line is located exactly in the center of the attitude indicator (the artificial horizon) and the vertical speed indicator shows a value of zero. When this happens, the horizontal speed on the airspeed indicator will increase again. This results from the conversion of climbing speed to additional horizontal speed. At this point, you need to trim the elevators again or reduce the throttle because the increase in speed creates additional lift forces.

10

Flying Straight and Level

Flying straight and level requires more than just sitting back, relaxing, and watching the beautiful scenery. You need to check your instruments to make sure you stay on course. To fly straight and level, you need to keep an eye on the altimeter, attitude indicator, airspeed indicator, and compass.

- The altimeter gives the primary indication of pitch performance. Check it periodically to make sure you are not gaining or losing altitude.
- The attitude indicator gives you bank-performance information. You want to make sure your heading remains constant.
- The airspeed indicator tells you how fast you are going. The more power that is applied, the faster the airspeed. The throttle, of course, controls the airspeed.
- The compass tells you whether your heading remains constant.

When you are flying straight and level, your instruments should look something like the ones in Figure 10.1.

- The altimeter remains constant
- The turn coordinator is level

- The turn indicator remains constant
- The vertical speed indicator is on 0

This step looks at correcting mistakes, instrument malfunctions, how to fly at cruising altitudes, how to maintain the right airspeed, autopilot, and Flight Simulator warning systems.

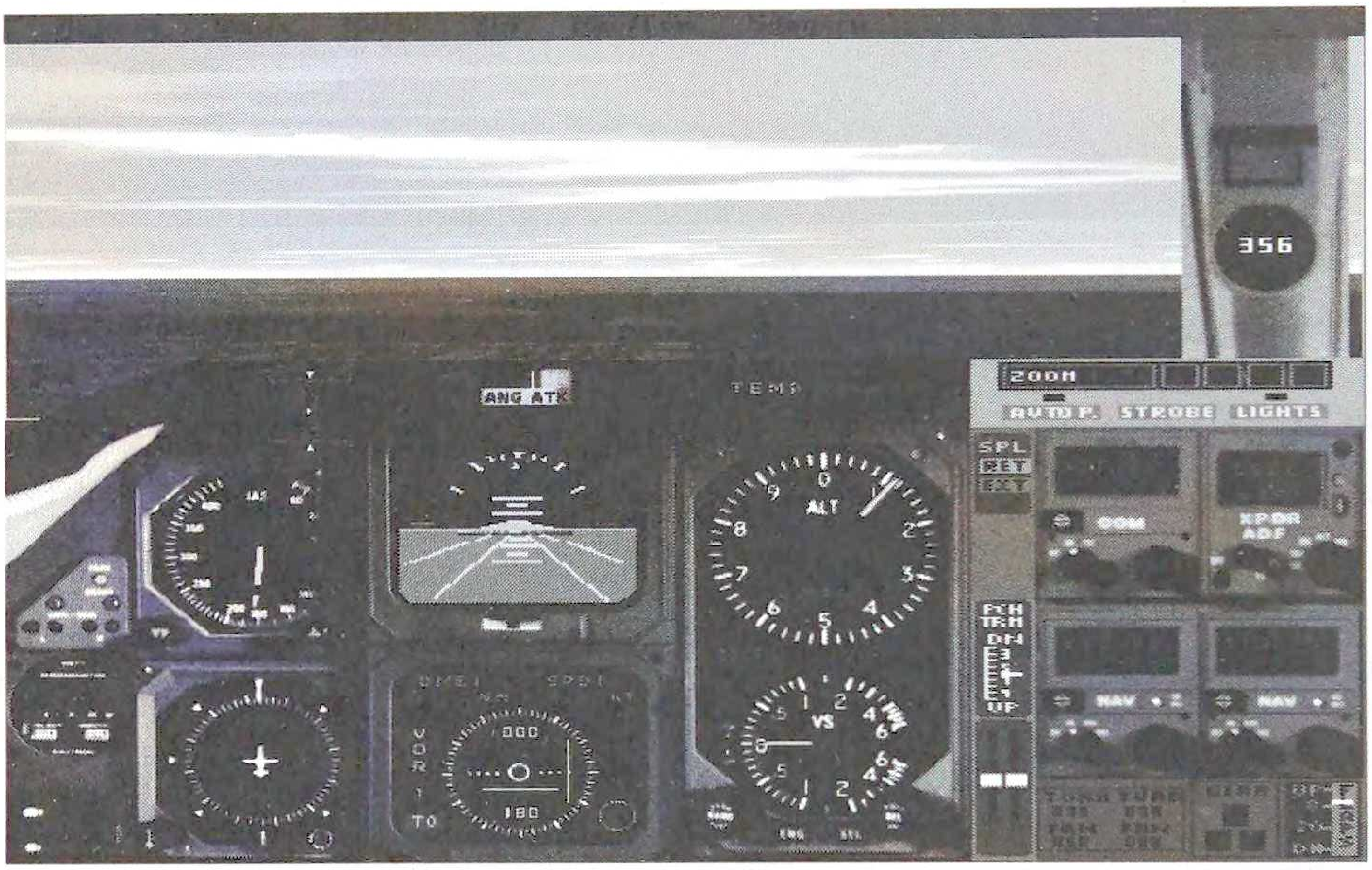


FIGURE 10.1: *Flying straight and level*

Correcting Mistakes

Part of flying is correcting problems when they arise. If you have drifted off your heading, turn back to the proper heading by banking the airplane towards the heading you desire.

TIP ***As a rule of thumb, the bank angle you use should equal the heading deviation. For example, if you are flying 10 degrees off course, roll the aircraft into a 10 degree left or right bank until you reach the straight-ahead heading.***

When you are flying straight and level, check the vertical speed indicator and the turn coordinator from time to time to see if these instruments are experiencing difficulties. For example, if the vertical speed indicator shows a 1000-foot-per-minute descent but the altimeter is holding steady, it means at least one of the two instruments is malfunctioning.

Maps

You might also want to check your map while you are flying straight and level. To check your map:

1. Select the menu bar.
2. Select View.
3. Select Map.
4. When a plus sign appears on screen, press NumLock to call up the map.
5. Zoom in and out by pressing the plus or minus key.

Flying at Cruising Altitude

TIP ***The most important condition for flying straight and level is to keep within one 100 feet of cruising altitude.***

Cruising altitude is also known as the "standard value for flying straight and level." To reach your targeted cruising altitude, adjust your elevators and the throttle. You should, of course, give yourself plenty of time to make the transition.

What do you do when you thought you were at cruising altitude but it turns out that your altitude is not correct? In other words, what do you do when you notice you are flying too high or too low? When this happens, make corrections with your throttle.

TIP ***When planes fly through areas of changing air pressure, their flight level remains exactly the same, but their true altitude above sea level can gradually change. In such cases, airplanes gradually climb and descend, which is hardly detectable, but power changes necessary to hold a constant airspeed may be noticeable.***

Maintaining the Right Airspeed

Airplanes are designed to fly straight and level when cruising near maximum airspeed. Normally, however, airplanes cruise slightly slower than maximum speed in order to conserve fuel. When an airplane is flying slower, less air passes over and under the wings and the airplane generates less lift. To compensate for this and generate more lift, raise the nose of the plane.

TIP ***Normally when an airplane is flying slower to conserve fuel, the nose is pitched up by 1 to 3 degrees. To make a plane slow down, sometimes more than just the nose is involved. Eventually flaps and slats are needed. Extending flaps and stats increases lift so that the required degree of nose-up pitch is less and the nose of the aircraft can be lowered. If you lose altitude, increase the throttle. If you gain attitude, decrease the throttle.***

WARNING ***Do not attempt to compensate for a drop in altitude by forcefully moving the elevators. Always use the throttle. Maintain airspeed by adjusting the power with the throttle and by cross-checking your RPM and airspeed.***

The key to good airspeed control is knowing how much power it takes to hold to specific airspeeds under varying conditions. For example, a Flight Simulator Learjet will hold at about 250 knots under 25 percent RPM at 3000 feet. At 30 percent RPM under the same conditions, a Learjet can hold an airspeed of 300 knots. Beyond that point, the relationship between RPM and airspeed increases, but more slowly.

Using the Autopilot

The autopilot is basically a stabilizing system capable of flying the airplane when the correct inputs are made. Autopolit saves the pilot from having constantly to fine-tune the flight controls, but it is not foolproof. You can tell an autopilot to fly a specific heading and specific altitude, and autopolit will monitor itself to maintain your parameters. It will also trim the airplane along its pitch axis. However, when the autopolit encounters bad weather, a change in route, an altitude change, or airspeed changes necessary for traffic separation, the pilot must tell the autopilot what change is needed. The autopilot cannot make these specifications itself.

TIP ***When you are on autopilot in cruise control, you do not need to control the flight. However, this isn't the case during the approach for landing. At that time, you have to use controls along with the autopilot.***

Warning Systems

While flying straight and level, you need to be aware of various warning systems. If you go too fast or too slow, or encounter threatening situations, the warning systems will alert you to potential dangers.

Speed Warnings

All airplanes, like automobiles, have maximum speeds. The maximum speed an automobile engine can accelerate, however, is well below the structural limits of the car body itself. Airplanes are built much the same way. A red line on the airspeed indicator, which varies with altitude, indicates the maximum, never-to-be-exceeded speed. Flight Simulator provides a warning beep and red lights to prevent you from exceeding the maximum speed. The airplane's built-in protections against flutter, vibration, and general structural strength are based on speeds 25 percent above the never-to-be-exceeded speed.

TIP ***Don't look for Flight Simulator overspeed warnings on the airspeed indicator. Instead, OVERSPEED will appear on your screen when you have exceeded the warning speed. Flight Simulator does give audio signals to warn you when you are going to fast. The OVERSPEED warning is shown in Figure 10.2.***

Fortunately, there is an easy cure for going too fast—just slow down.

ACTION ***You can slow down an airplane by retarding the power or by deploying the speed brakes to increase the aerodynamic drag.***

Stalls

Airplanes stall when not enough air passes over and under the wings. The result is insufficient lift, which produces a stall. An

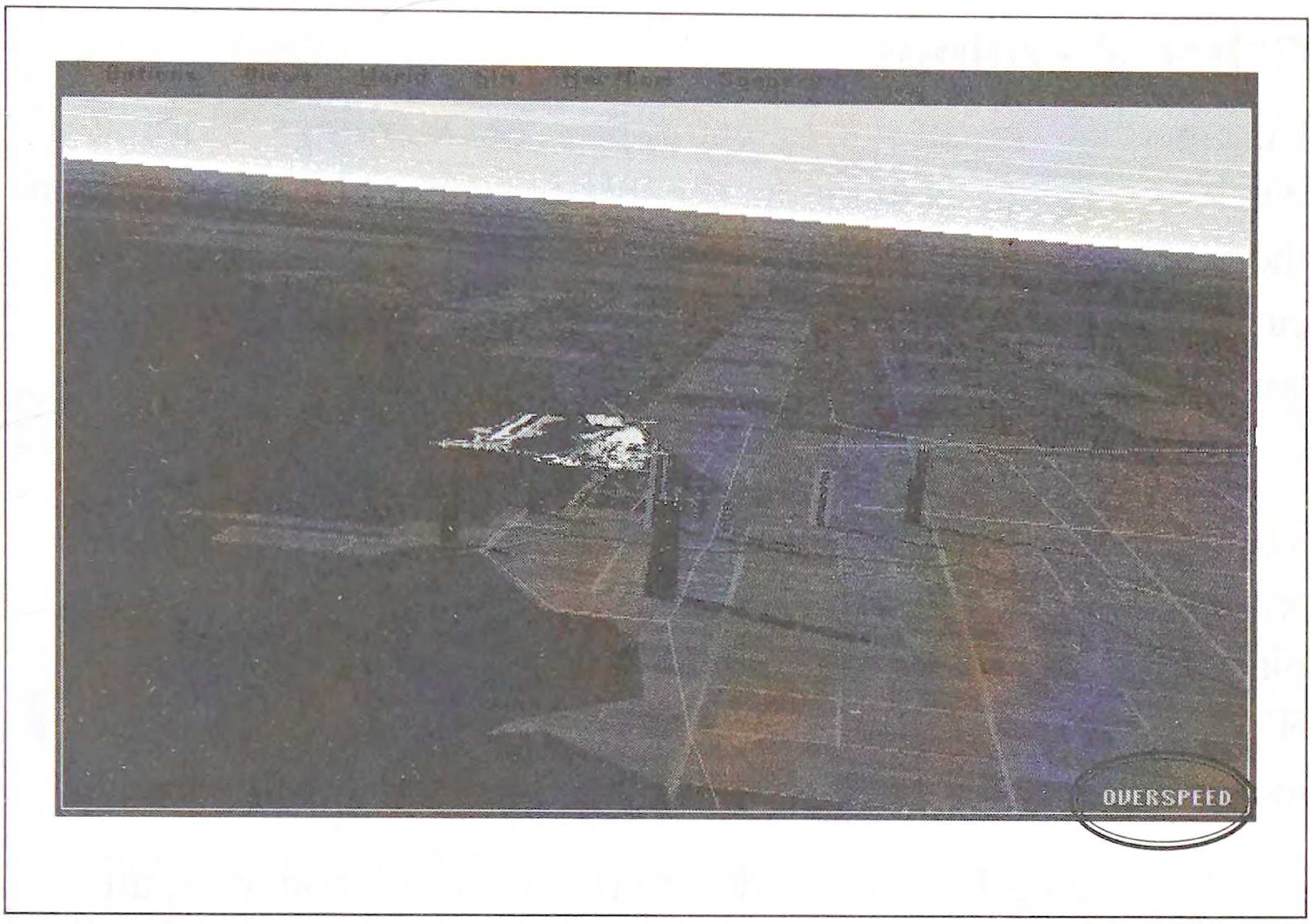


FIGURE 10.2: *The OVERSPEED warning*

airplane's stall speed varies with its

- flap configuration
- weight
- altitude
- angle of bank

An airplane will not fly below its stall speed.

TIP ***Pilots never fly anywhere close to their minimum speed. Airspeeds for slow-speed flight during takeoff and landing are calculated on a minimum margin of safety. If the plane inadvertently slows to within 5 percent of the stall speed, lights and horns alert the pilot before the stall occurs. On Flight Simulator, you will see the word STALL in big letters on screen. You will also hear a warning beep.***

Other Warnings

Commercial airplanes have cabin pressure warnings. Normally when an airplane is cruising, the interior cabin altitude is kept at the 6000 to 7000 foot level. If the cabin pressure decreases and causes the cabin altitude to rise above 10,000 feet, a warning sounds.

Some airplanes have a ground-proximity warning system. Tied to the radio altimeters, the ground-proximity warning system is activated within 2500 feet of the ground. Many new airplanes are also being outfitted with windshear alert systems. *Windshear* refers to an extreme change in wind direction and velocity over an extremely short distance.

If the autopilot isn't working properly or disconnects, an autopilot-disconnect system will activate in some planes. Lights will flash and horns will sound. Finally, some airplanes now have speed-brake extended warning systems, auto-throttle disconnect cautions, altitude deviation cautions, and fire warnings.

11

Making Turns

The mechanics of an airplane turn are simple. Turns depend on the ailerons. Airplanes, like boats, lean when they turn. Pilots use their controls such that one set of ailerons on one side goes up while the other side goes down. In turns, the wings develop slightly different amounts of lift. The side with more lift goes up while the other side goes down. Pilots roll out of a turn by applying the opposite aileron until the attitude indicator shows that they are centered and on course.

TIP ***In most flights, pilots limit bank angles to 25 to 30 degrees. Even the largest commercial jets, however, are capable of more than double that amount. Pilots do, however, practice steep turns in recurrent training.***

This step explains how to turn your airplane, how to make standard turns and other kinds of turns, and how to turn in uncoordinated flight.

How the Ailerons and Rudder Work in Turns

You turn an airplane by banking and yawing it towards the direction you want to go. As you know, the ailerons are used to bank the plane, and the rudder is used to yaw. When you use Flight Simulator's auto-coordinated Flight mode, however, the ailerons and the rudder move in tandem.

When you make a turn, you continue turning at the specified angle until you roll out of the turn. You can do this using controls or allow Flight Simulator to do it for you. Flight Simulator makes provisions for wing *dihedra*l effects, the angles at which the wings are pointed upwards, and so will straighten your airplane out after a few minutes of flight.

Timing is crucial when you are rolling out of a turn. As a general rule, apply the opposite aileron/rudder when your heading indicator shows a reading 10 degrees less than your desired heading. For example, if you want to proceed on a heading of 170 degrees, begin rolling out of the turn when the compass indicates a 160-degree heading. Because you are still in a bank while rolling out of a turn, you continue to turn even while you level off.

WARNING ***Always check the altimeter when you have completed a turn. Do this because turns cause you to lose altitude. The steeper the bank, the greater the altitude loss. Raise the elevators as you are turning to compensate for altitude loss.***

• • Shallow, Medium, and Steep Turns

There are three types of turns:

- ***Shallow.*** Shallow turns have a bank angle of less than 20 degrees.
- ***Medium.*** Medium turns have a bank angle between 20 and 45 degrees.
- ***Steep.*** Steep turns have a bank angle of more than 45 degrees.

Standard Turns

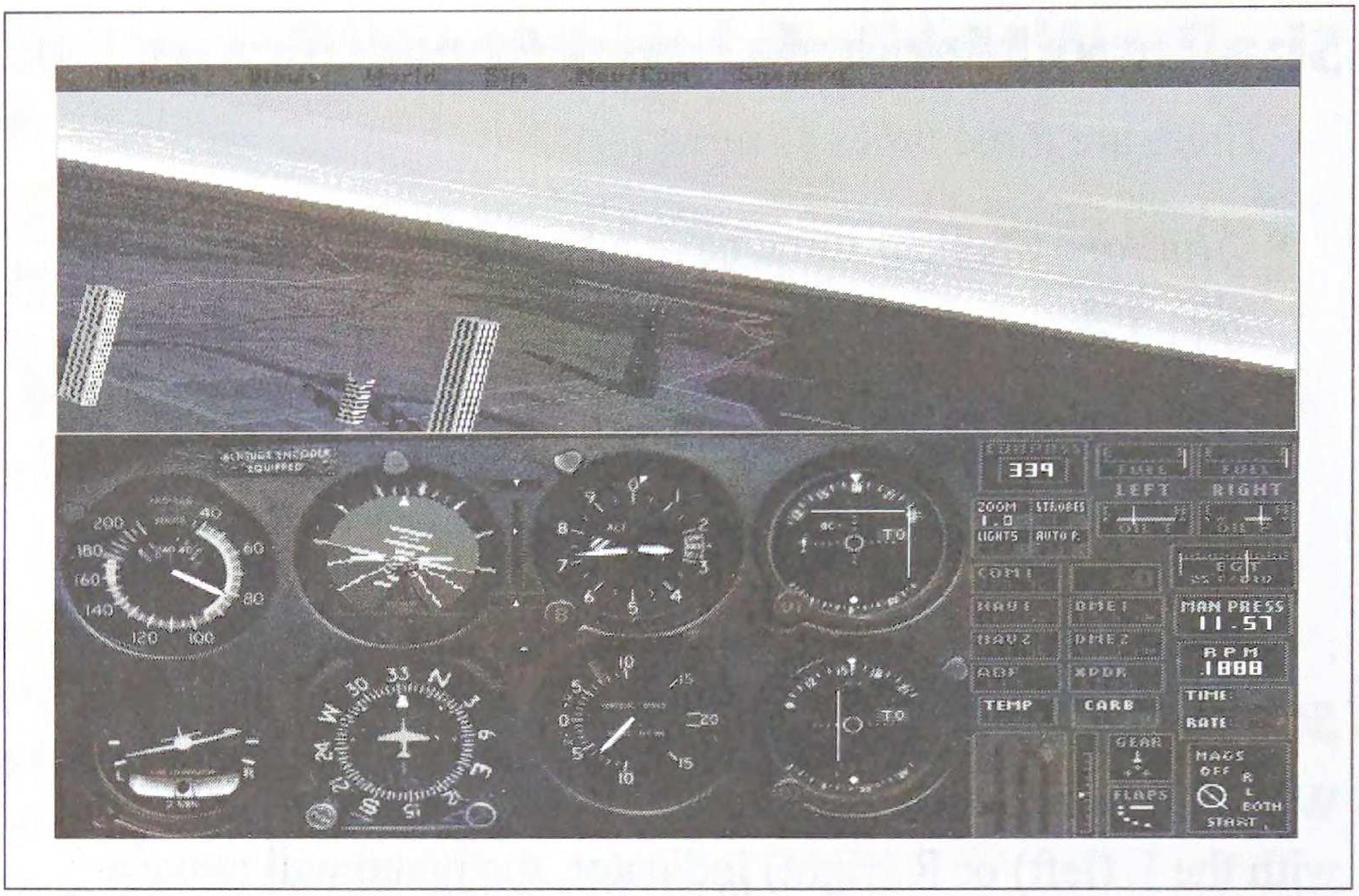
When the wings of the plane symbol in the turn indicator align with the L (left) or R (right) indicator, the plane will make a standard turn. If you set the turn indicator like this and fly for two minutes, the plane will complete a 360-degree turn and be headed once again in the original direction. In other words, the turn rate is three degrees per second.

No one, of course, makes full standard turns. However, you use a standard turn as a way of measuring all turns. Figure 11.1 shows a standard turn. Note the instrument readings.

You must also take into account airspeed when calculating the bank and roll angle. You can use this simple rule of thumb:

Bank angle in degrees (standard turn) =
7+(Airspeed in knots/10).

If the banking speed changes due to external forces, such as winds, you would make corrections with the help of the altitude indicator.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COM1
NAV1
DME1
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DME2
ADF
XPDR
EGT
MAN PRESS 11.57
RPM 1888
TEMP
CARB
TIME
RATE
GEAR
FLAPS
MAGS OFF R L BOTH START
TO

FIGURE 11.1: *A standard turn*

TIP ***As a practical suggestion, you should make sure the "airplane" in your turn coordinator stays aligned with the L or the R during a standard turn.***

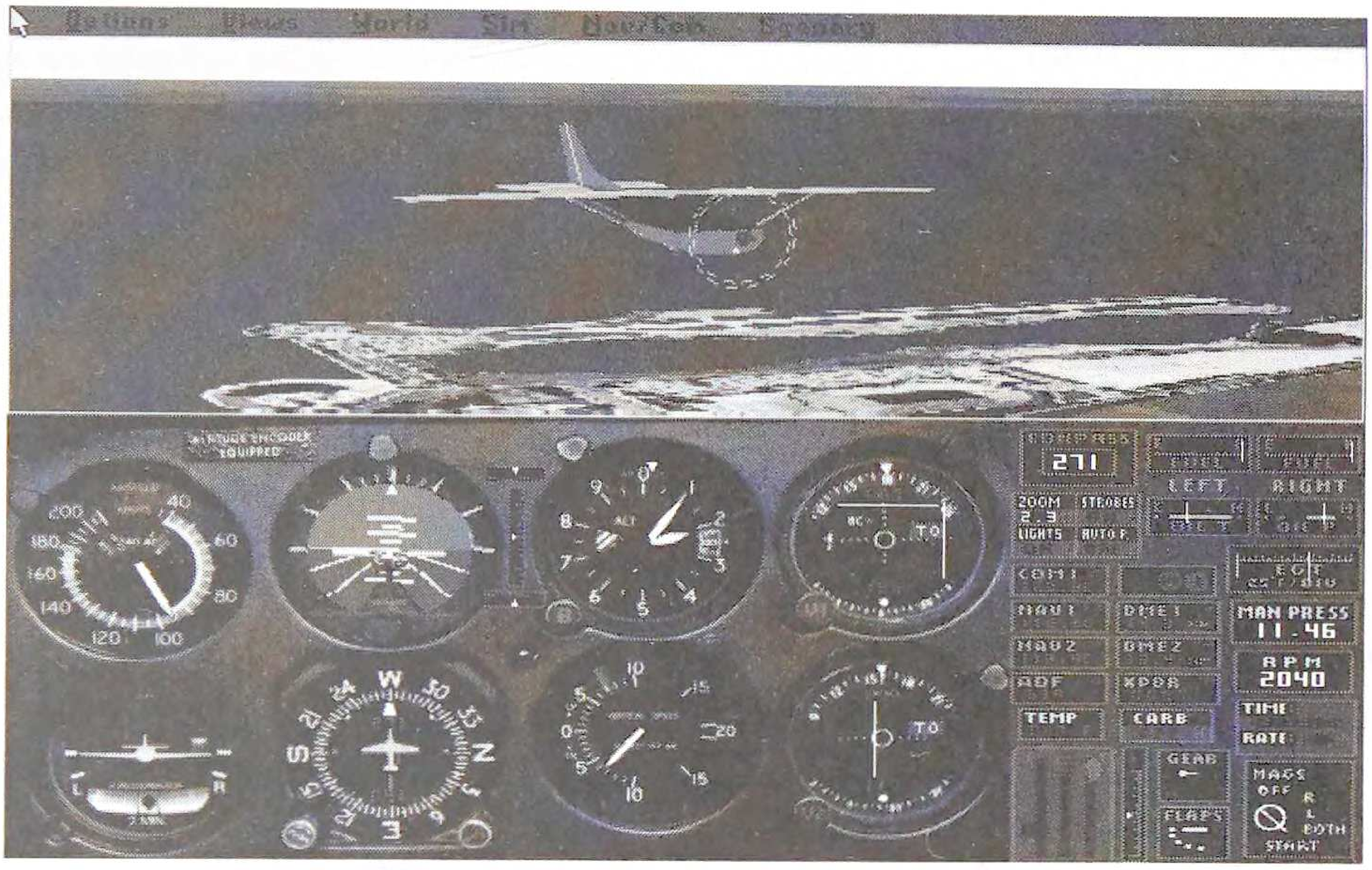
Ending a Standard Turn

In order to reach the targeted heading, you need to roll out of the turn at just the right time. That right time is calculated mathematically with the formula:

Integer degree value for initiating rollout = Bank angle/2

Let's say, for example, that you were making a standard turn with a bank angle of 25 degrees at a speed of 120 knots. You would start the rollout at 25/2, or $12\frac{1}{2}$ degrees.

After you finish making your turn you should move the elevators to return to a straight and level flight. Then, check the attitude indicator to make sure you are flying straight and level. Finally, check the altimeter to make sure you are neither gaining nor losing altitude. Figure 11.2 shows what the instruments and view look like when coming out of a standard turn.


Options
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NAV 2
ADF
TEMP
DME 1
DME 2
XPDR
CARB
MAN PRESS
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RPM
2040
TIME
RATE
GEAR
FLAPS
MAGS
OFF
R
L
BOTH
START

FIGURE 11.2: *Completing a standard turn*

TIP ***Charles Gulick offers a tip for pilots who lose control of their airplanes during a standard turn: Make sure you do not overcontrol your airplane. Remember to center the aileron after you apply it.***

Medium and Steep Turns

You make a medium turn exactly the same way you make a shallow turn. The difference, however, is that the airplane's tendency to drift back to level flight in a standard turn unless more aileron is applied is not in effect. The airplane will turn without any additional applications of the ailerons. On the other hand, a steep turn requires you to reverse the ailerons. If you don't, the airplane will bank even more steeply.

Turns in Uncoordinated Flight

You can turn off the link that moves the rudder and ailerons together. To do this:

1. Select the menu bar.
2. Select Sim.
3. Select Auto Coordination.

An airplane is most efficient and safest in the coordinated mode. In the uncoordinated mode, if you use the rudder alone, the airplane will skid as it drags itself around a turn with the coordinated ball pushed to one side. On the other hand, relying solely on the ailerons will result in a slow, choppy turn.

Accelerated Maneuver Stalls

Stalls entered from such flight situations as abrupt path changes, including turns, are called *accelerated maneuver stalls.* While useful in acrobatics, stalls generally should be avoided. In fact, prolonged stalls should always be avoided.

To perform an accelerated maneuver stall:

1. Get into a banked turn at about 45 degrees.
2. Apply increasing back pressure on the elevators until the airspeed reaches the design maneuver speed (the speed at which maneuvers that create excessive G forces could damage the aircraft's structure).

3. Increase back pressure until a stall occurs.

To recover from an accelerated maneuvering stall:

- Release back pressure and increase power.

12

Bringing the Plane Down

As you recall, a takeoff takes place in stages. So does a landing. Those stages are:

- The approach
- The descent
- The landing

First you will approach an airport, a complicated process that may or may not end in your landing there. Like takeoffs, landings require careful coordination with the ATC.

In the best of all possible flight worlds, with no Air Traffic Control, no conflicting air traffic, and no wind or inclement weather, pilots could descend on a three to one line: for every three miles of distance traveled toward the destination, 1000 feet of altitude would be lost. If the plane were cruising at 35,000 feet, an ideal descent would begin no later than 105 miles from the airport. An additional 16 miles would be added to the 105 to ensure smoothness during a slow transition from cruise to descent.

In the real world, however, pilots have many factors to consider:

- Tailwinds might make it necessary to start the descent earlier to compensate for the increased speed over the ground.
- Headwinds might require a later top of descent point, or a more gradual rate.
- ATC altitude restrictions might require an airplane to descend in stages, with step-down clearances similar to the step climbs on the way up.
- The ATC might insist that the airplane take a slight detour so it can be sequenced with other arrival traffic.

This step explores the three key areas of landing—the approach, descent, and finally the touchdown.

• • • Approaches

Approaches are divided into three categories: CAT I, CAT II, and CAT II.

- CAT I approaches allow a descent to a minimum-decision-height altitude of 200 feet above ground level and a landing with 1800 feet forward visibility, which is measured by the RVR (runway visual range).
- CAT II minimums are a decision height of 100 feet AGL and 1200 feet RVR.
- CAT III represents the epitome of high-technology approaches. Here no decision height is stipulated because a full autopilot-autoland system is required and used to land the airplane. Required visibility is 300 feet RVR. Very little if any of the runway, however, will be seen by the pilots before touchdown.

Airports must adhere to higher standards to receive and maintain CAT II and CAT III certification. Airplanes using this capability must be equipped and maintained to higher standards, and their pilots specifically trained in low-visibility landing procedures.

Visual Approaches

In the visual approach, you use instrument and visual techniques together. In other words, a pilot may use radar coverage, electronic-approach guidance, full localizer and glide slope information—but he or she also must watch the runway and other aircraft from long distances. In fact, spacing between airplanes can be safely decreased by using "visuals." For example, aircraft can fly side-by-side approaches to parallel runways closer than 4300 feet together when visibility is not restricted.

Visual approaches are also used for noise-abatement reasons. For example, Washington's National and New York's LaGuardia Airport both have similar noise-abatement visual approach procedures. In addition, some airports, weather permitting, use visual approaches as part of the "keep them high" noise-abatement policy, where aircraft regularly are required to maintain altitudes above the normal three-degree descent path.

Entry: The First Step

ACTION *The first step in entry is to reduce power. Usually you will drop your power by about 500 RPM at this point. Next, you use pitch to control the vertical descent. Adjust the power again to the cruise speed you want.*

After you have adjusted the power to the cruise speed you want, you begin descending steadily. The descent rate—also called the sink rate—is measured in vertical feet per minute. The descent lasts until the plane is 10 percent of its vertical speed from the goal altitude. In other words, if the goal altitude is 1000 feet and the plane is descending at 600 feet per minute, the pilot would level off at 1060 feet.

Use your throttle and control your pitch to level off. First you increase the throttle to cruise power, and as you slow for the approach, the pitch is increased to compensate. Often aircraft land with their noses pitched up 5 to 7 degrees. Airplanes are designed that way so the main landing gear in the back can touch down on the runway first.

Speed Brakes

Because airplanes are designed with very little aerodynamic drag, even with the power back to idle, airplanes can be difficult to slow down in a descent. Jets, however, have speed brakes, those large panels near the trailing edge of the wing. Normally the panels are completely stowed in the zero-degree position, but are raised in any increment from zero to 40 degrees. The extra drag serves to slow the aircraft down.

Gliding

If there were no descent restrictions, you could start to reduce power on all engines from just beyond the top of the descent point and idle and glide to your destination. In fact, the most fuel-efficient descent actually safely incorporates idle-power glides.

Using Flaps and Slats during the Approach

When the flaps and stats are fully or partially extended during an approach, the additional aerodynamic drag creates a vibration that can be felt in the airplane. Each flap position has a minimum and a maximum speed. The minimum speed provides a 30 percent margin over the stall speed. The maximum speed is a fixed speed limit never to be exceeded without risking structural damage.

The first several flap positions, combined with slat extension, do the most to increase the wing's lifting capability. Additional flap extension will increase the drag.

The Landing Gear

When you are five to seven miles from the runway, it is time to lower the landing gear (provided your airplane is the type with retractable landing gear). The landing gear create a lot of drag. To lower the landing gear:

- Press G.

TIP ***Extending the landing gear prematurely, by increasing drag, can help increase the descent rate without increasing airspeed.***

Landing gear should be down and locked when the airplane is:

- A minimum of three miles from touchdown
- 1000 feet above the ground

When you finally land, the flaps will be in landing position. Figure 12.1 shows a Cessna with the landing gear down.

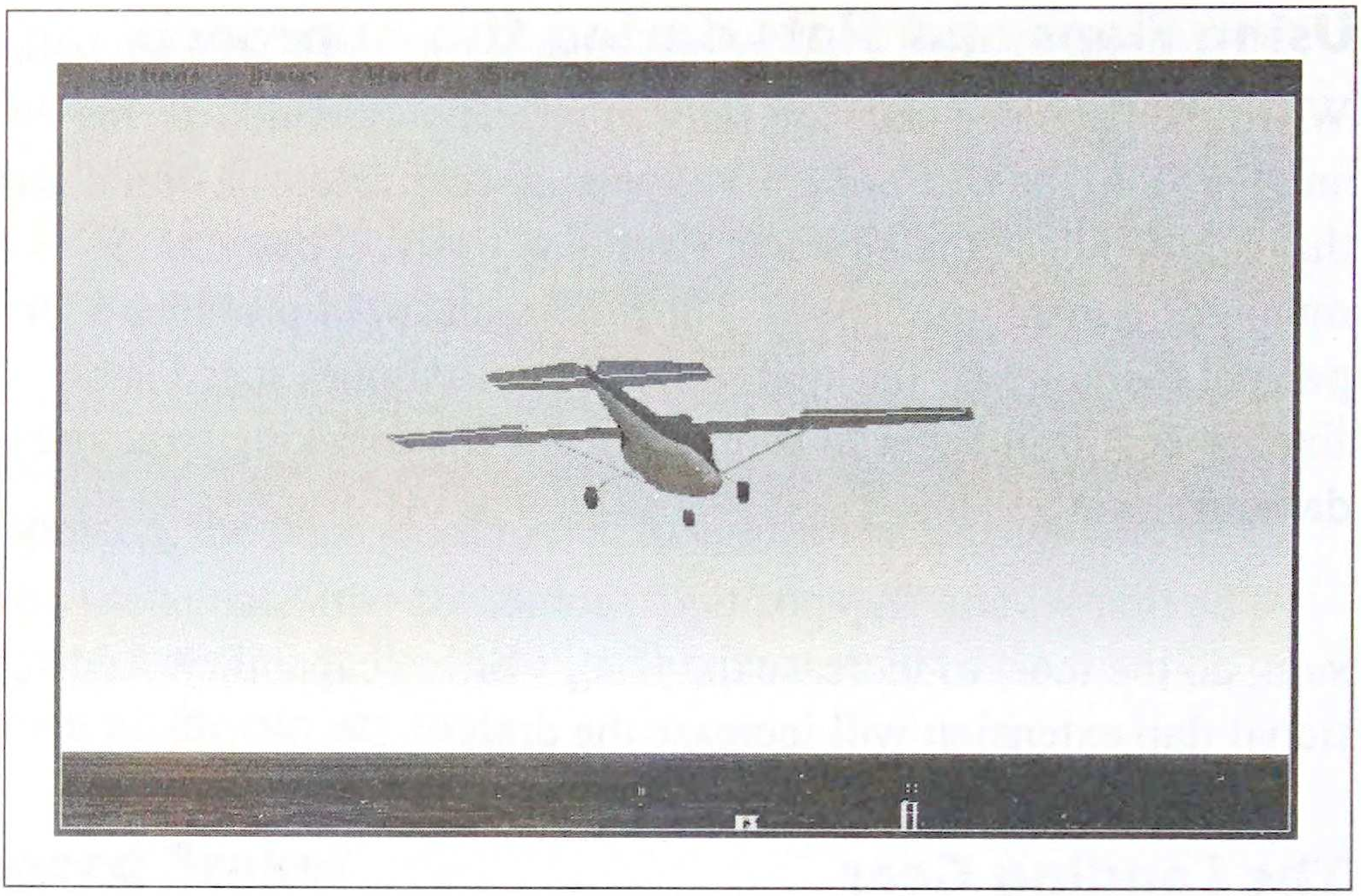

FIGURE 12.1: *The landing gear down*

Approaches and the ATC

During the approach, the Sterile Cockpit Rule applies as it did during takeoff. This rule, set by the Federal Aviation Administration, forbids communication between the pilot and control tower except to matters relating to the takeoff and landing of the plane. To increase the spacing between incoming planes, the ATC usually requests the pilot to make a speed adjustment.

Now the use of vectors comes into play. *Vectors* are turns that branch off the published arrival route. In some cases, all the ATC does is order a few turns left and right to adjust the traffic pattern perfectly. In other cases, however, when the ATC is saturated with inbound traffic, the ATC will order the plane to enter a holding pattern. A *holding pattern* is an oval orbit.

Sometimes airplanes get stacked up in a holding pattern. This happens, for example, during periods of bad weather, when an airport has to close temporarily. Planes in holding pattern can never be closer than 1000 feet.

During approach delays, the ATC issues an "expect further clearance" or "expect approach clearance" time, but these times can change. Delays are a nuisance but safety makes them unavoidable.

Go-Arounds

One of the reasons pilots keep in touch with the ATC is that they are not always permitted to land even when given the go ahead to do so. *Go-arounds,* also known as *missed approaches,* are more common than you would imagine. They are not an emergency procedure. Nor are they caused by pilot error. In fact, go-arounds usually occur because a plane was slow to clear the runway and couldn't get off in time to let the next plane land. When this happens, the landing clearance is withdrawn because aircraft cannot share runways.

When two aircraft get closer than is normal on the approach, the ATC will ask one aircraft to slow to its minimum speed early and increase the separation between airplanes. When this happens, the ATC alerts the pilot to the possibility of a missed approach, but lets the plane continue. If the first plane is not able to make the first turn off, then a go-around is mandatory.

TIP ***Flight Simulator does not require contact with the ATC for approaches and landing. You can and should, however, call up the ATIS on the COM radio.***

. . . The Descent

Slow descents are used during landing approaches. As you approach your targeted goal—say, 75 knots—use pitch control to get there. Once you arrive at the target speed, use the elevators to maintain it. If you are going too slow, however, point your nose up. This will help you keep up the speed. Figure 12.2 shows the starting position for landing.

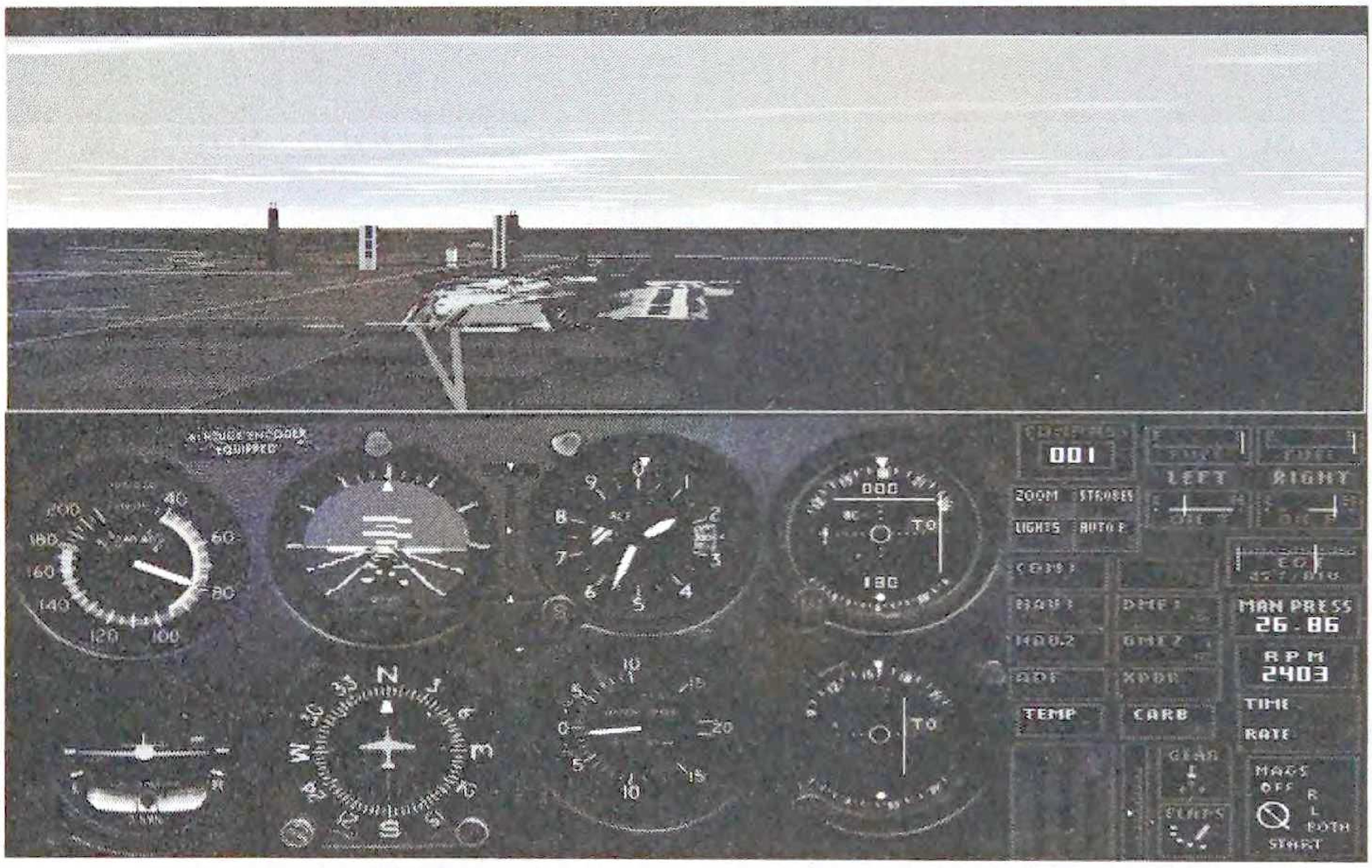
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FIGURE 12.2: *The starting position for landing*

WARNING ***Descend slowly before you try to land an airplane with Flight Simulator. You need to learn how to work in this stage before you try a touchdown.***

As a rule of thumb, during a slow descent you use pitch to control airspeed and power to control vertical speed. During your descent, you need to watch airspeed and angle. Airspeed is important because if you go too fast you will hover over the runway or overshoot it. If you go too slow, you may touch down before the runway. If you think you are going to overshoot the runway, cut your power, but if you think you are coming in too short, add power.

Angles are important because long approaches can bring you in contact with ground obstacles.

WARNING ***Never try to stretch the glide by applying back elevator pressure alone to reach the targeted landing spot. This strategy will actually shorten the gliding distance. Always be sure to add power as well.***

The Flare

As you approach the runway, you will notice large white rectangular boxes painted on the runway on both the right and left sides 1000 feet from the threshold. These mark the touchdown aim point. If you are flying an electronic glide slope, this point is where the slope intercepts the runway.

The "flare" begins after the threshold is crossed. The *flare* is the round-out portion of the landing where the descent rate is decreased from speeds such as 700 feet per minute to practically zero at touchdown. As you flare, the nose is raised farther than its nose-up pitch on the approach. This increases the pitch, which increases the lift and slows the descent.

The airspeed over the "numbers"—the runway identification numbers painted just past the threshold—should be a minimum of 30 percent over stall speed. In the flare, however, applying extra power requires a longer runway on which to slow down and stop the plane. Sometimes pilots increase the power fairly rapidly just prior to touchdown and then pull to idle. Increasing power is one way to stop your descent rate. You can also raise the airplane's nose.

ACTION ***When you are 10 to 20 feet above the ground, the flare is started. Apply the elevator so that the wheels can be held about one foot above the runway. The airplane will bleed off speed. In other words, in an almost Zen-like fashion, your object becomes not to land the airplane. Instead, you will induce a stall at 49 knots with the elevators pulled far back.***

As you maneuver for your approach to land, slow down further and increase the pitch to compensate. Large aircraft often land with their nose pitched up 5 to 7 degrees. This enables the main landing gear in the back to touch down on the runway first.

Dealing with Stalls

The airplane is designed to stall as you land. However, because conditions are never symmetrical for the wings, one wing usually stalls slightly before the other. Losing all the lift on one wing causes the plane to bank quickly in the direction of the stalled-out wing, and can cause the plane to roll. Fortunately, modern aircraft design minimizes this roll. Still, you should always be aware of it.

To simulate an accidental stall during a landing approach, you can perform a power-off stall with normal landing approach conditions.

WARNING ***Before a stall, check the practice area to make sure that it is clear of traffic. Also, be sure you are flying high enough above ground level to recover once the stall is completed.***

Icing is great when you're talking about cakes, but deadly when you are talking about power-off stalls. Anyone who has ever faced an iced-up carb in a car can easily understand why you need to be especially concerned about icing during a power stall.

To perform a power-off stall:

1. Apply carb heat to prevent icing and cut the power.
2. Drop the landing gear and move the flaps down. For example, you want to cut a Cessna's speed to below 85 knots and a Learjet's to below 200 knots before doing this.
3. Move the flaps down and use the elevators to hold in a constant-altitude flight. Be sure to maintain control with the rudder.
4. Raise the nose, keep the wings level, and then raise the ailerons.
5. While maintaining directional control with the rudder, hold the ailerons until the stall occurs.

To recover from a power-off stall:

1. Reduce the elevators and apply full throttle slowly.
2. Lower the nose as necessary to regain flying speed.
3. Return to a straight and level flight.

The Landing

Touchdown occurs on the main gear first. The last several inches make the difference between a smooth landing and one that isn't so smooth. If runways were of infinite length, a smooth landing could be accomplished nearly every time, because the power could be reduced very slowly and the pitch adjusted in minute increments.

Because runway length is a consideration, always try for the perfect touchdown, but without wasting excess runway in the process. Factors such as fog, rain, and gusty winds sometimes make it necessary to touch down faster than you would want.

You should think of the touchdown aim point as 1000 feet from the threshold. If you aimed for the front edge of the runway, there would be no margin for error for landing short.

Surprisingly, once a plane has touched down on the runway, it is still not committed to land. In fact, a training maneuver called a "touch and go" consists of touching down, rolling a short distance down the runway, and taking off again.

Spoilers

After the main gear touches down, larger airplanes deploy spoilers. Spoilers are over-wing panels that "spoil" the lift. In some cases, airplanes have enough speed to keep flying. Airplanes with a manual spoiler extension can skip on landing, but the extra available lift can cause a slight bounce back into the air. Automatic spoilers, on the other hand, remove this possibility because the panels are lowered automatically when the main gear touches down.

After the main gear touches down, the nose gear is lowered to the runway. Pilots try for a smooth landing of the nose gear, but sometimes this is not possible.

After a smooth flight, you might be disappointed by a less than smooth approach. However, the airplane on approach is back to the low-altitude environment it was in during takeoff.

Convective air can cause gusty winds and a low-level chop. However, the area of greatest concern during the approach is wake turbulence, known as *wing-tip vortices*. The wing tip is the only place on the wing where the differential pressures of the air swirling from the bottom to the top tries to equalize. This circular motion can develop tremendous speed, temporarily upsetting the air even on a smooth, calm day.

Landing in a Crosswind

TIP ***You should land an aircraft as directly into a headwind as possible. A touchdown with an airspeed of 135 knots into a 10-knot headwind means the ground speed is 125 knots. This reduction in ground speed (in this case 10 knots) makes for a shorter landing roll, slow down, and stop.***

A tailwind landing one way is a headwind landing when you attempt it in the other direction. Usually the wind is not moving straight down the runway, so a crosswind component requires calculations. Actual winds are given on the ATIS weather tape or by the control tower. Taking the actual wind, pilots can compute how much wind is headwind and how much is 90-degree right or left crosswind. For example, if a 20-knot wind at 45 degrees is blowing on the left side of the airplane, the headwind would be 10 knots (half) and the direct crosswind component 10 knots (half).

During an approach into a crosswind, the pilot will keep the plane level. However, the airplane's nose will not be directly aimed at the runway. Aiming the nose upstream, toward the crosswind, will maintain a path over the ground straight to the runway.

The touchdown technique also changes because of a crosswind. Just before touchdown, the plane is banked into the wind and the nose held straight with the rudder. Because the airplane is in a slight bank at touchdown, the upwind landing gear will land first.

WARNING ***The STALL warning should go off just before you land.***

13

The Instrument Landing System (ILS)

The Instrument Landing System (ILS) is designed so you can line up the nose of your plane with the runway. It is designed for one purpose: to make your final approach a safe one, especially in bad weather and low visibility.

An ILS transmitter, located at the runway, sends signals to the multiple ILS receivers on board the airplane. The transmitter sends out two signals:

- A *localizer signal,* transmitted in a narrow horizontal beam 6 degrees wide, tells you whether you are directly on course.
- A *glide slope* beam tells you whether you are on the correct *glide slope,* the slope you should take as you come to the runway.

NOTE ***A normal glide slope is anything but steep. Normally the glide slope is 3 degrees. At 3 degrees, an airplane must lose 300 feet of altitude per mile during the approach.***

This step explains how the ILS instruments can help you with landings. The instruments are shown in Figure 13.1.

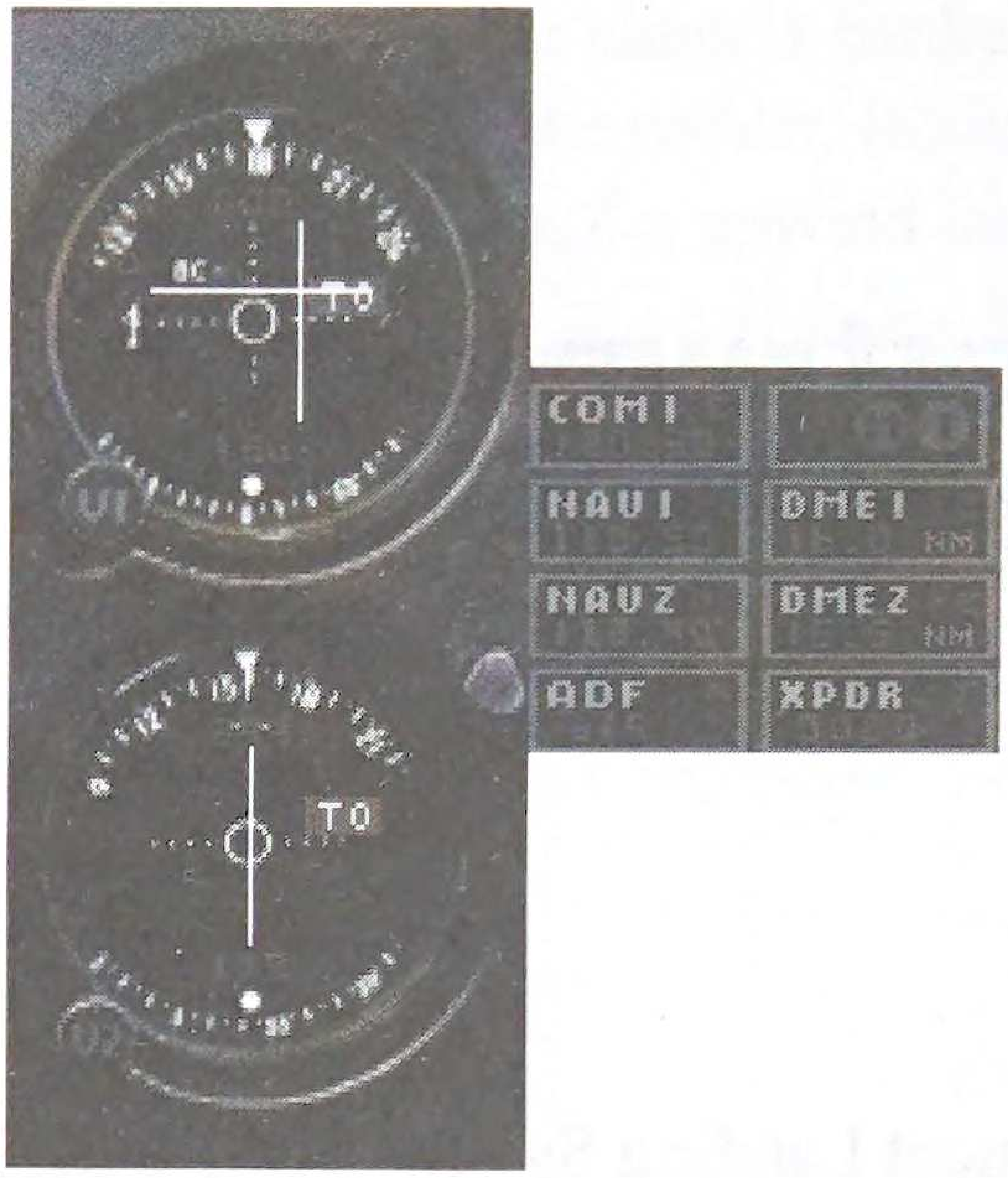


FIGURE 13.1: *The ILS instruments*

Reading the ILS Instruments

An ILS system includes altitude-marker beacons, lights, and runway markings. About a half a mile before the runway starts, a high-intensity approach lighting system can be seen from the cockpit. Sequence flashers and white strobe lights flash in rapid-fire succession to help you align the plane with the runway. Runways also have runway edge lights, runway touchdown zone lights, and runway centerline lights.

The ILS instruments have two needles, one for the localizer and one for the glide slope:

- The vertical needle is the flight localizer needle. When it is centered exactly, that means the airplane is directly in line with the runway's center line. If the needle is not centered, turn the plane slightly to move the needle back to the correct course.

- The horizontal needle is the glide slope indicator. It is four times more precise than a localizer. Being just 14 feet too low or high over the runway causes needle function problems.

TIP *You can also study the landing approach by using the head-up display (HUD) window projection EFIS/CFPD system. Choose Nav/Com on the menu bar, select EFIS/CFPD, and choose a flight path.*

Riding the Glidepath

The *glidepath* is the optimum path to the runway. It is shown in Figure 13.2. Whether your plane is on the glidepath can be determined with information supplied by the glide slope transmitter and the localizer transmitter.

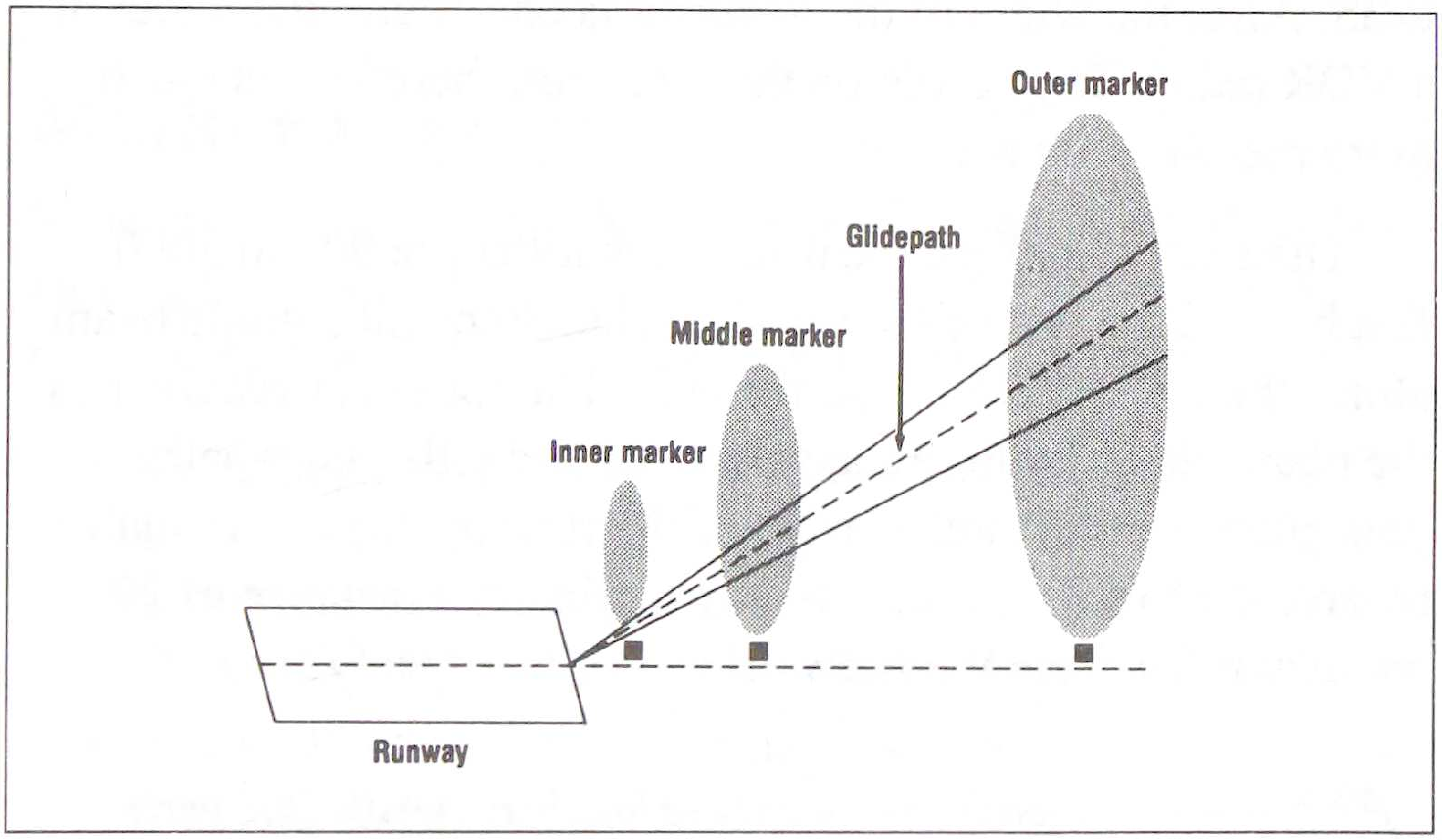


FIGURE 13.2: *The glidepath*

TIP ***When adjusting your course during landings, make small adjustments. Oversteering can be fatal when you get close to the ground.***

The Localizer Transmitter

The heart of the ILS system is a localizer, a specialized navigation aid that creates an electronic path in the sky toward a runway. The localizer frequency is entered into the aircraft's ILS system, and the aircraft can then pick up this path and fly it into the runway. You enter a localizer frequency in Flight Simulator by using Nav radio 1 the same way you enter VOR frequencies.

The localizer transmitter provides you with horizontal guidance during the landing. It sends out a VOR-like radial that is lined up with the runway. Unlike a VOR, however, a localizer has only one fixed course, and it will not vary if you turn the OBS. Also, the width of the localizer is one-fourth the width of a VOR radial. The needle on the indicator, therefore, is much more precise in its reading.

The antennas of the localizer transmitter are 900 to 3000 feet beyond the end of the runway. They transmit a guide beam along the center line of the runway. The localizer receiver in the plane picks up these transmissions and tells you whether your plane is to the left or right of the runway. You can usually receive the localizer transmission starting at a distance of 20 nautical miles from the runway.

ACTION ***Ideally, you want the localizer needle (the vertical one) centered. If you are off to one side, steer toward the middle of the needle. Once the needle is centered, resume your original heading course toward the center of the runway.***

The Glide Slope Transmitter

The glide slope transmitter, on the other hand, provides vertical guidance. It ensures that your airplane is flying at the correct altitude and will descend at the proper rate. The glide slope guidance beam is sloped at an angle 2 to 4 degrees from the ground and tells you whether your plane is above or below the correct descent path.

ACTION ***The glide slope needle (the horizontal one) should be centered. If the needle is above or below center, you are above or below the glide slope. Reduce or increase your descent rate until the needle centers itself.***

In the end you know you are on the right glidepath when the vertical and horizontal needles are locked onto the center point of the OMI.

Marker Beacons

Radio marker beacons provide the pilot with information about how far the plane is from the runway. As Figure 13.2 shows, there are three markers: an outer marker, middle marker, and inner marker.

- The outer marker. When you fly over the outer marker, located about five miles from the runway, you'll hear an acoustical 400-Hz signal (two long beeps per second) and the blue O lamp on the OMI indicator lights will flash.
- The middle marker. At 0.6 nautical miles from the runway, a 1300-Hz signal (a long beep followed by a short beep) sounds and the yellow middle marker lamp comes on.

- The inner marker. Flight Simulator does not tell you when you have reached the inner marker, as the program does not have this feature.

When the Glide Slope Fails…

Every once in a while, either the glide slope transmitter on the ground or the glide slope receiver in the aircraft fails. In these cases, you have to depend on the approach lights for navigation (see below). How often the glide slope fails depends on the reliability setting you chose with the Realism and Reliability option on the Sim menu.

LIGHT TYPE	USE
VASI	The visual slope indicator lights, a series of two layers of color-coded lights. If you are flying too high, they will appear white. If you are flying too low, they will all appear red. However, if you are on the glideslope, they will appear red above white.
REIL	The runway end identifier lights, two flashing lights on both sides of the runway. These lights help you distinguish the runway from the area around it.
MALSR	The medium-intensity approach lighting system, the row of strobe lights that looks like tracer shells being shot at the runway.

TABLE 13.1: *Flight Simulator Approach Lights*

Approach Lights

As you approach the runway, watch the runway lights very carefully. The approach lights are identified in Table 13.1.

Precision Approaches

One of the key differences between precision and ILS instrument approach procedures is that precision approaches do not have *minimum descent altitudes* (MDAs). Instead, precision approaches are made along the glide slope to a decision height (DH), at which time the pilot must decide whether the requirements to continue the approach have been met. Care should always be taken to ensure that the minimum descent altitude is not exceeded.

ILS instrument approach procedures require you to coordinate speed, power, and attitude. For example, if your angle of descent is 2 degrees and you are traveling at 30 knots, the recommended rate of descent is 105 feet per minute. On the other hand, if your angle of descent is 12 degrees and your ground speed is 180, the recommended rate of descent is 3780 feet per minute.

When flying with instruments, most ILS instrument approach procedures allow a pilot to descend to a mere 200 feet above the touchdown zone elevation before committing to the landing.

14

Flying the Learjet, Sailplane, and Sopwith Camel

If you've grown bored with flying the Cessna, cheer up. Flight Simulator provides three other airplanes, each with its own quirks and idiosyncrasies. This step looks at flying the Learjet, the Sailplane, and the Sopwith Camel.

• • Flying the Learjet

The Learjet, shown in Figure 14.1, presents you with all kinds of new possibilities and new challenges. The major difference between the Gates Learjet and the Cessna is that the Learjet is much larger and heavier. Consequently, it is equipped with high-performance jet engines. However, this increase in power comes at a price: the Learjet is much slower to respond to commands than the other three planes. And once you commit to a maneuver, it takes longer to come out of it. This is especially true of landing.

FIGURE 14.1: *Flying the Learjet*

New Instruments

TIP ***To see additional instruments on the Learjet 35A, press the Tab key.***

The Learjet has several instruments not found in the Cessna. These instruments have unique commands. You can switch, for example, between the VOR 1, VOR 2, and ADF gauges by pressing Shift-Tab.

The jet starter switch has its own set of commands. To select the jet starter switch:

1. Press J+1 or J+2.
2. Press the plus key (+) or the minus key (-).

Airspeed Indicator

The airspeed indicator on the Learjet gives true airspeed instead of indicated airspeed.

To select an airspeed indication:

1. Select the menu bar.
2. Select Options.
3. Select Preferences.
4. Select Instrument.
5. Select the Display Indicated Airspeed check box.
6. Select OK.

Getting the Learjet under Control

The streamlined Learjet, with its two powerful General Electric CJ610-8A turbojets, can fly at great speeds. Mach .82 is the maximum operating speed, and if you exceed Mach .82 the warning system will activate. You will hear a warning buzzer. When this happens, reduce power and reduce climb.

WARNING ***If you let the Learjet travel too fast over the maximum speed, supersonic shock waves travel back on the wings. The controls, as shown by the aileron indicator, will begin to buzz and snatch wildly from side to side. Your airplane is out of control.***

To get back in control of a Learjet, *do not* activate the spoilers to slow down. This will only drop the nose and make you go faster. Instead, turn off the power and pitch up.

TIP ***Consider lowering the landing gear as a last-ditch effort to get control of a Learjet. This creates minor damage to the system but adds drag to help stabilize the airplane.***

Landings

Learjet landings are especially tricky. The best way to land is to reach the runway numbers with the proper speed and rate of sink. If your rate of sink is too high, you will hit the runway hard. If you come in too fast, you will float above the runway while your jet bleeds off speed.

Flying the Sailplane

To learn more about flying the Sailplane, try the built-in instruction demo. To view this demo:

1. Select the menu bar.
2. Select the Options.
3. Select Video Recorder.
4. Select Sailplane Soaring.
5. Select OK twice.
6. When the demo is over, select OK and press P to resume flying.

The Sailplane has many of the features of other airplanes, including elevators, ailerons, a rudder, and all the respective controls. But it also has *terminal high-velocity dive brakes.* These brakes are surfaces that extend, like flaps, from within the wings. They are used to control the angle of descent. On Flight Simulator, you use the same controls you would use to control flaps to control these brakes.

Terminal high-velocity dive brakes either extend or retract. Extending the brakes increases drag. In other words, they slow you down during a vertical descent. This effect disappears when you retract them.

Flight Techniques

TIP *Because the Sailplane doesn't have an engine for propulsion, its natural inclination is to descend. You can reverse this trend, however, by riding in places where the air is pushing away from the earth. In other words, you can maintain your altitude, or even climb, when the air is rising at a rate equal to or faster than the Sailplane's rate of descent.*

Although you can't start the Sailplane from the ground, you can fly the Sailplane in any area you can fly the Learjet or the Cessna.

WARNING *Always remember to start the Sailplane from a sufficiently high altitude to guarantee a long flight.*

Two of the most common forms of lift are *ridge lift* and *thermal lift*. Both kinds of lift are available in the San Francisco region in Flight Simulator.

Ridge Soaring

Ridge soaring is possible because hills and mountains redirect the wind. When wind flows into the side of a ridge, it is deflected upward. A Sailplane can fly for a long time, covering great distances, as long as the pilot guides the Sailplane to places where the lift is greatest and the winds continue to blow.

The Sailplane Soaring demo starts off with a demonstration of ridge soaring. When your run this demo, you will find your Sailplane riding the air currents in Marin County, northwest of San Francisco's Golden Gate Bridge, as in Figure 14.2. You head southeast along the ridge, gradually ascending in rising air. Notice Mt. Tamalpais, a good source of wind.

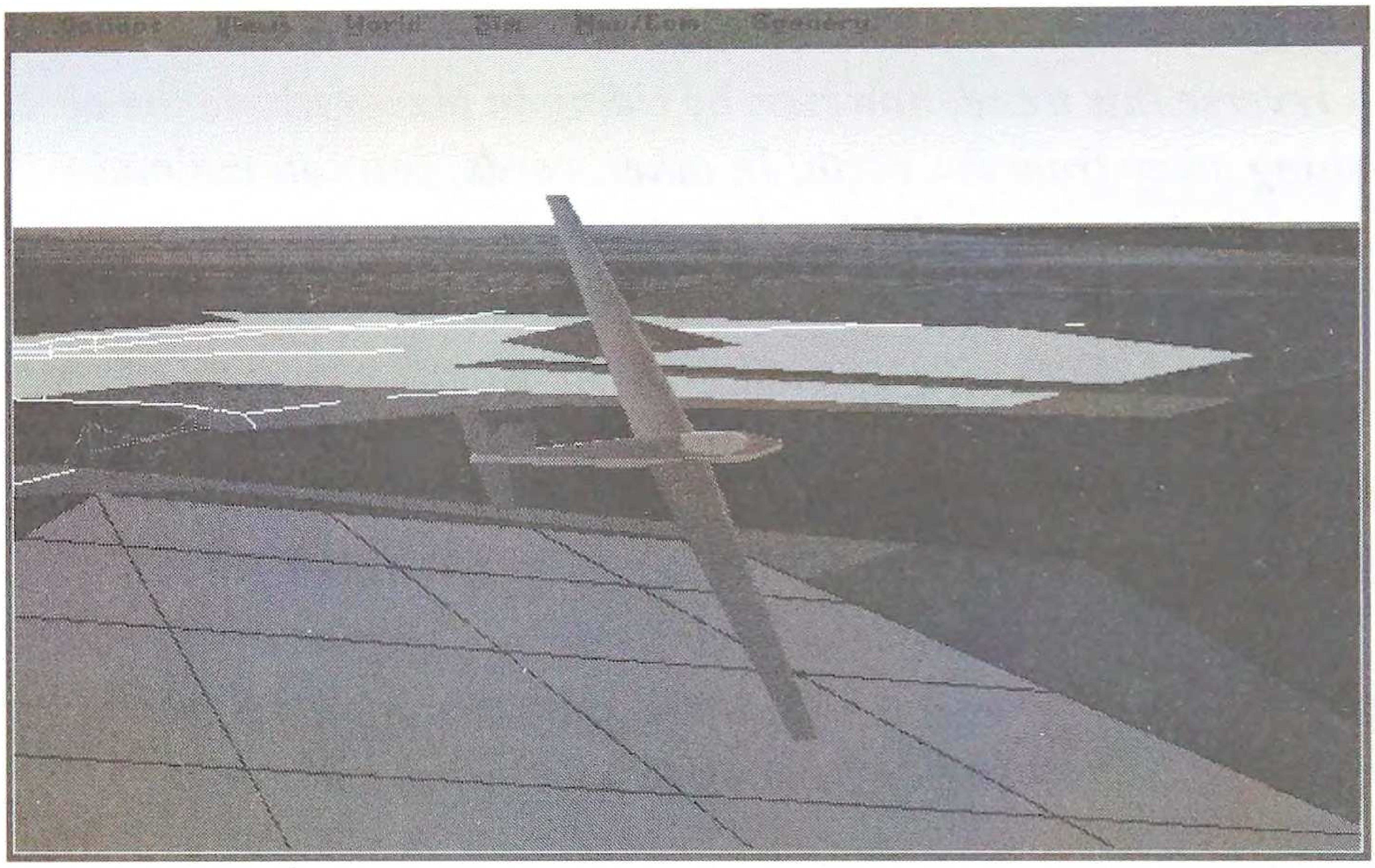


FIGURE 14.2: ***Ridge soaring near the Golden Gate Bridge***

WARNING ***Watch your position in relation to the top of the ridge. If you fly too far over the ocean, you will lose the ability to ridge soar. Without hills to deflect the air upward, the air over the ocean is neutral or descending. Also, do not fly on the east side of the ridge. The air becomes turbulent there as it spills over the top. Whenever possible, fly just in front of the ridge, on the Pacific Ocean side. Watch the vertical speed indicator to learn the areas of best lift.***

TIP ***The flight path for ridge soaring usually is a figure 8. In the beginning, you will fly a more conservative path. However, as your skills increase, try extending your flight range by gaining as much altitude as possible and then exploring.***

Remember, when you fly in areas away from the lift, you need enough altitude to return to the ridge and work your way back up in the rising air.

Never let the Sailplane descend too low (except when you are landing). You may not have enough altitude to make it to the landing strip, which is located near the base of the north end of the ridge.

Thermal Soaring

Thermal soaring is possible because hot air rises. The sun heats the earth's surface, which, in turn, heats the air above it. Some parts of the earth absorb more heat than others. Green fields absorb more than brown deserts, which means that deserts release more heat into the air and are better for thermal soaring.

NEW ***After you finish the Ridge Soaring demo, Version 5 automatically continues to a Thermal Soaring demo.***

TIP ***When you are soaring, you need to wait for the perfect moment before committing to a turn. Turn the Sailplane only after the wind raises one of the wings. You should adjust the brakes and the vertical rudder to climb at a bank of 30 degrees, gaining altitude quickly by using circular movements.***

When you reach the desired bank, neutralize the ailerons.

If you need more altitude, keep circling over a thermal field. Finally you can adjust the vertical rudder and brakes to level off the Sailplane when you have gained enough altitude.

• • • Flying the Sopwith Camel

The Sopwith Camel is the lightest and most maneuverable of the four aircraft you can fly with Flight Simulator. However, it lacks many of the features that modern pilots take for granted. Retractable landing gear, flaps, and complex navigational equipment won't be found on the Camel.

Because of its small size and relatively high wing area, the Camel enjoys the smallest turning radius and highest responsiveness of any aircraft in Flight Simulator. But do not try flying long distances. It can carry only a small amount of fuel.

15

Slewing and Other Computer Tricks

Because Flight Simulator is a computer program, you can do many things that would be impossible in a real airplane. *Slewing,* which means moving from point to point very quickly, is probably the most useful thing you can do. This step explains slewing and also how to move to a new location and change simulation speed.

• • Slewing

Slewing lets you move around Flight Simulator very quickly. You can make the airplane appear instantaneously in a new place.

To slew:

1. Select the menu bar.
2. Select World.
3. Select Slew.
4. As shown in Figure 15.1, move the joystick in the direction you want to go. Moving the joystick left or right rotates the airplane on the yaw axis, after which you can go forward again. Pulling back on the joystick backs you up.

5. When you are done and you want to return to normal flight, select Slew again.

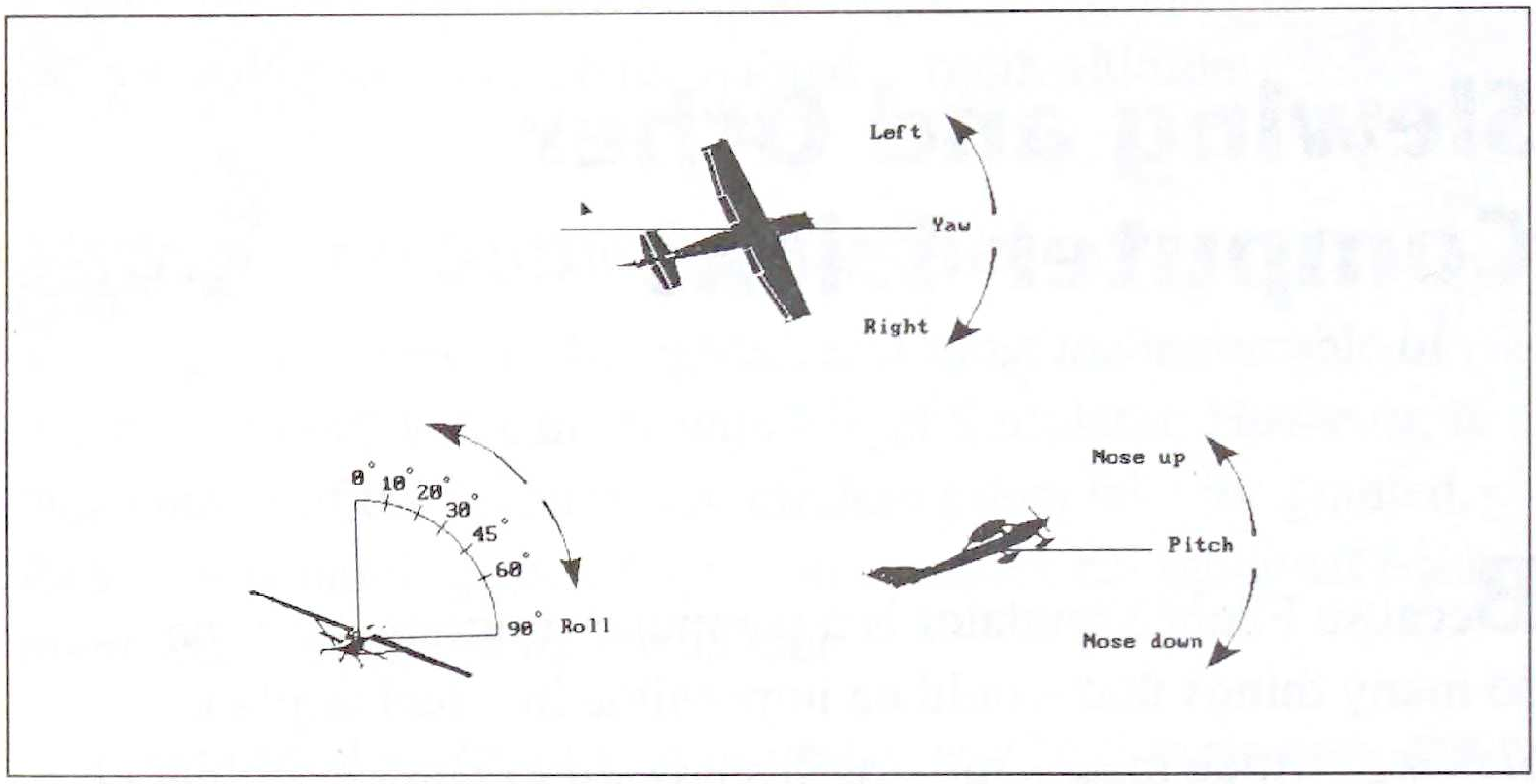


FIGURE 15.1: *Determining the slew direction*

TIP *You can also get into Slew mode by pressing Y on the keyboard.*

You will notice that red letters and numbers appear on your screen when you slew.

Slewing requires it own commands. These commands are listed in Table 15.1. Notice that the commands fall into five categories—heading, movement, altitude, pitch, and bank. The numbers in Table 15.1 all refer to numeric keypad numbers, not the numbers on the main keyboard.

• • • Setting Exact Location

You can also move to an exact location and change your heading by using the Setting Exact Location menu.

SLEW CONTROL	FUNCTION ON TOP	FUNCTION ON LEFT
Heading		
Left	1	1
Right	3	3
Freeze	5	5
Movement		
Forward	8	8
Backward	2	2
Right	6	6
Left	4	4
Freeze	5	5
Altitude		
Up	F4	F2
Freeze	F2	F6
Down	F1	F10
Pitch		
Up	F5	F1
Freeze	F6	F5
Down	F8	F9
Bank		
Left	7	7
Right	9	9
Freeze	5	5

TABLE 15.1: *Slew Commands*

To select the exact location:

1. Select the menu bar.
2. Select World.
3. Select Exact Location. A dialog box appears.
4. Type in the information. You can either type in a longitude and lattitude or use Flight Simulator's X\Z coordinate system. You also the enter the altitude and heading.
5. Select OK.

TIP ***When you set the altitude, set your plane for a high altitude if you're going somewhere you've never been before. If you don't, you could end up underground.***

The advantage of using this setting is that you move instantly. The disadvantage is that you miss watching the scenery go by.

Changing Simulation Speed

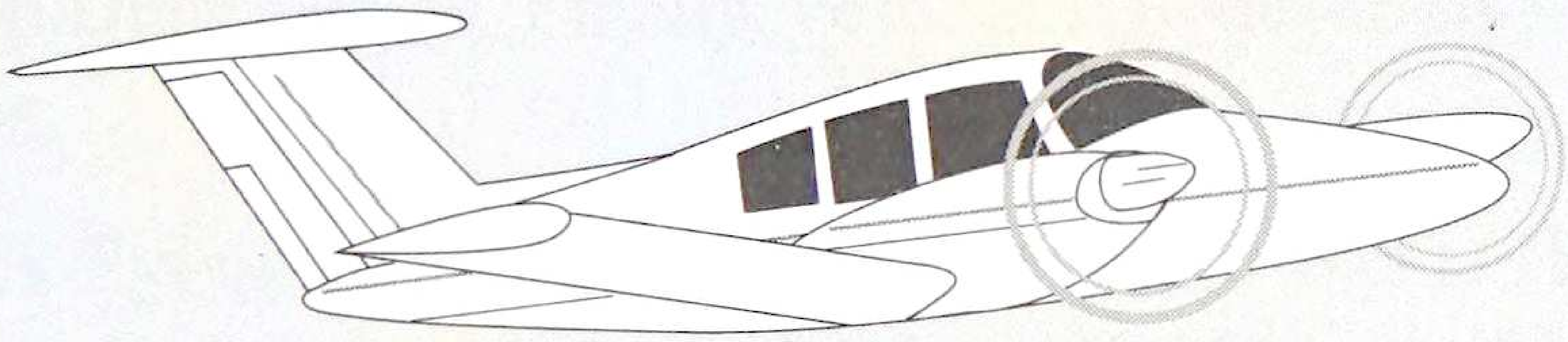
If you like the realism of a Flight Simulator flight, but just want the whole darn thing to speed up, you can change the simulation speed.

To change the simulation speed:

1. Select the menu bar.
2. Select Sim.
3. Select Simulation Speed.
4. Select a speed from the list box.
5. Select OK.

PART THREE

• • • THE WILD BLUE YONDER



16

Trick Flying

As you become a better flyer and you begin to master the basics, you can begin "trick flying" or "barnstorming." When you begin advanced flying, take advantage of Flight Simulator's built-in flight instructor. You can practice agricultural flight with the Crop Duster game. Finally, you can fly with friends over modems.

Trick flying came into its own after World War I. The United States government sold Curtis JN-4s, called "Jennys," after World War I for only $400 each. Many military pilots became barnstormers, touring the United States and doing stunt flights in cities and small towns.

These daredevils flew upside down, walked on the wings of their planes, jumped from plane to plane in midair, and performed mock battles.

You can try trick flying with any Flight Simulator airplane. This step explains how to perform the difficult maneuvers—including spins, loops, inverted flight, formation flying, crop dusting, and dual flights.

TIP ***Before you give aerobatic flying a whirl, you can have Flight Simulator's instructor give you tips. Select the Flight Instructor option on the Options and take a peek at the lessons listed in the box under Acrobatic.***

The Spin

The spin is the simplest aerobatic maneuver. A spin is really a stall with one wing stalling before the other. Any airplane can do it. In fact, many airplanes spin accidentally, so pilots should master the final (recovery) stage of a spin whether they are interested or not in spinning for its own sake. In any event, the flight path of a spin looks like a corkscrew.

To execute a spin start:

1. Select Uncoordinated Flight to make your rudder and aileron work independently. To do this, select the Sim menu and select the Auto Coordination box.
2. Climb high, to an altitude of at least 10,000 feet.
3. Move the throttle back to idle power.
4. Raise the elevators so that the nose points slightly above the horizon. The stall warning will sound. Now is where the action really starts.
5. Raise the elevators and move the rudder to the left to spin left, or move the rudder to the right to spin right. The view from the cockpit should look something like Figure 16.1. The plane will roll to at least a 90-degree bank.

Congratulations! You are spinning. To recover from a spin:

6. Use the full opposite rudder to stop the rotation and lower the elevator to reduce your angle of attack.
7. Raise the elevator to raise the nose to the horizon.

WARNING ***Don't raise the elevator too quickly to end a spin or a loop. If you do, the airplane may stall again.***

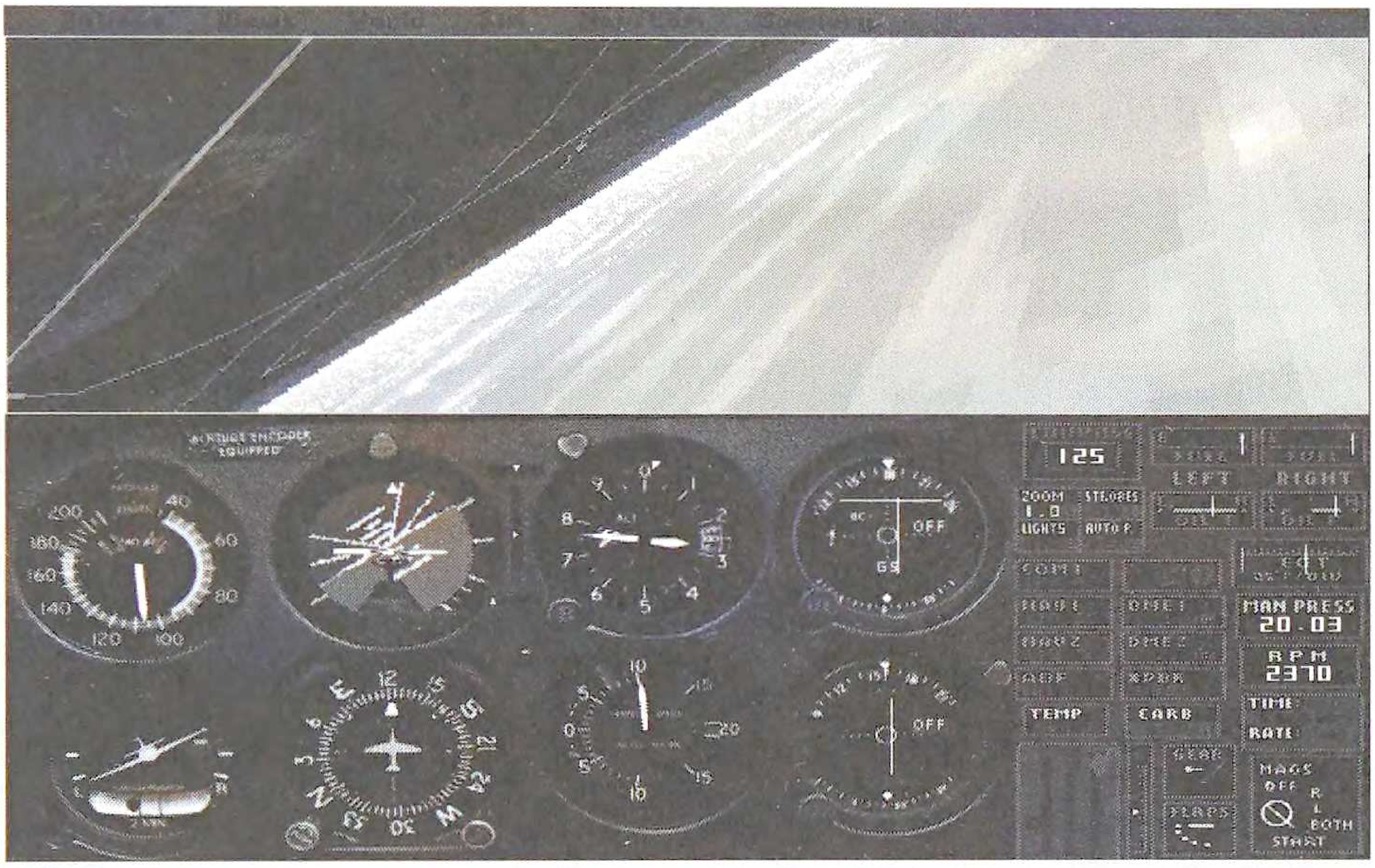

125
ZOOM
1.0
STROBES
LIGHTS
AUTO P
LEFT
RIGHT
MAN PRESS
20.03
RPM
2370
TEMP
CARB
TIME
RATE
GEAR
FLAPS
MAGS
OFF
R
L
BOTH
START
OFF

FIGURE 16.1: *Going into a spin*

The Loop

As you would expect, a loop is a vertical circle. To try a loop yourself:

1. Select auto-coordinated Flight mode and climb to a high altitude, say 10,000 feet.
2. Use the elevator to dive rapidly.
3. When airspeed reaches about 200 knots, apply the up elevator smoothly, but not too rapidly, until it is about three-fourths up.
4. Apply full throttle after the nose rises. You'll see blue sky in the windshield.
5. Look at a side view to see your pitch orientation.

6. Switch to a front view when the loop is nearly half complete, and watch the earth reappear upside down, as shown in Figure 16.2.
7. Bring the throttle back to near idle to avoid over-revving your engine as you dive.
8. Level off and apply the throttle to resume a normal cruise flight.

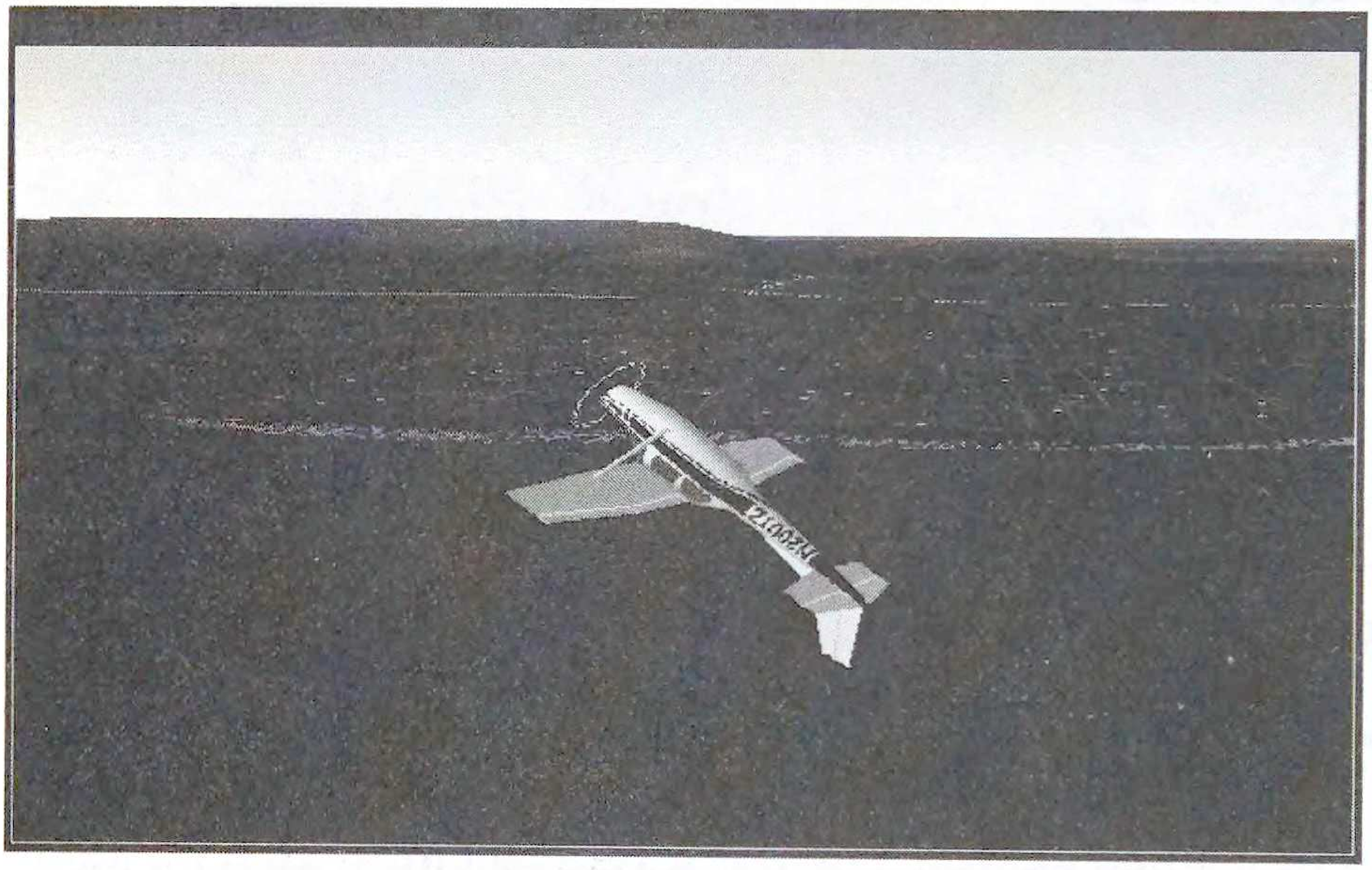


FIGURE 16.2: *Sliding down the loop*

• • • The Aileron Role

An *aileron roll* is a role using the ailerons only. To accomplish an aileron roll:

1. Turn off auto-coordination.
2. Climb to a height of at least 6000 feet.
3. Make sure your airspeed is about 100 knots.

4. Pitch back slightly and make sure the nose is above the horizon. Now you are climbing slightly.
5. When the nose is just above the horizon, bank hard to the right or left.
6. As the plane rolls inverted, push forward on the joystick. That will keep the nose from dropping to far.
7. Continue to hold full left or right aileron.
8. As you roll back into a normal flight, pitch back again on the joystick to pull your nose up.
9. When you see the horizon, come out of the roll just like you would a normal turn.

• • • The Immelman

The *Immelman* is named after Max Immelman, a Word War I pilot. An Immelman is a half a loop followed by half an aileron roll. To do an Immelman roll:

1. Go into a loop as explained above.
2. When you come over the top of the loop and see the inverted horizon, roll the airplane as you would if you were doing an aileron roll (see above).
3. Complete half the aileron roll, and you should be flying straight and level.

• • • Flying Upside Down

Suppose you just want to fly upside down? To fly upside down:

1. Begin a shallow dive to pick up 30 knots over cruise speed.
2. Use the elevators to raise the nose slightly above the horizon, and then neutralize the elevators.

3. Apply the left or right aileron (depending on which direction you want to roll).
4. Neutralize your ailerons shortly after rolling past 90 degrees. This will make sure the plane stays upside down.
5. Use the reverse elevator to control pitch. Continue flying level upside down.

WARNING *If you start losing altitude while upside down, remember to push the nose down (use the down elevator).*

• • • Formation Flying

Flight Simulator is even more fun when you have more than one airplane on the screen at a time. Flying this way is called flying in formation. To fly in formation:

1. Select the menu bar.
2. Select Options.
3. Select Entertainment.
4. Select Flying in Formation.
5. Select OK.

The Formation Flying menu lists seven startup situations. For example, you can fly through a city and weave around buildings, following the lead plane all the while. Remember, you're flying in formation: if you crash, the lead plane will not crash with you.

TIP *The lead plane leaves a smoke trail to make it easy to follow, as shown in Figure 16.3. If you get too far behind, however, you can move your airplane closer to the lead plane by pressing the Spacebar.*

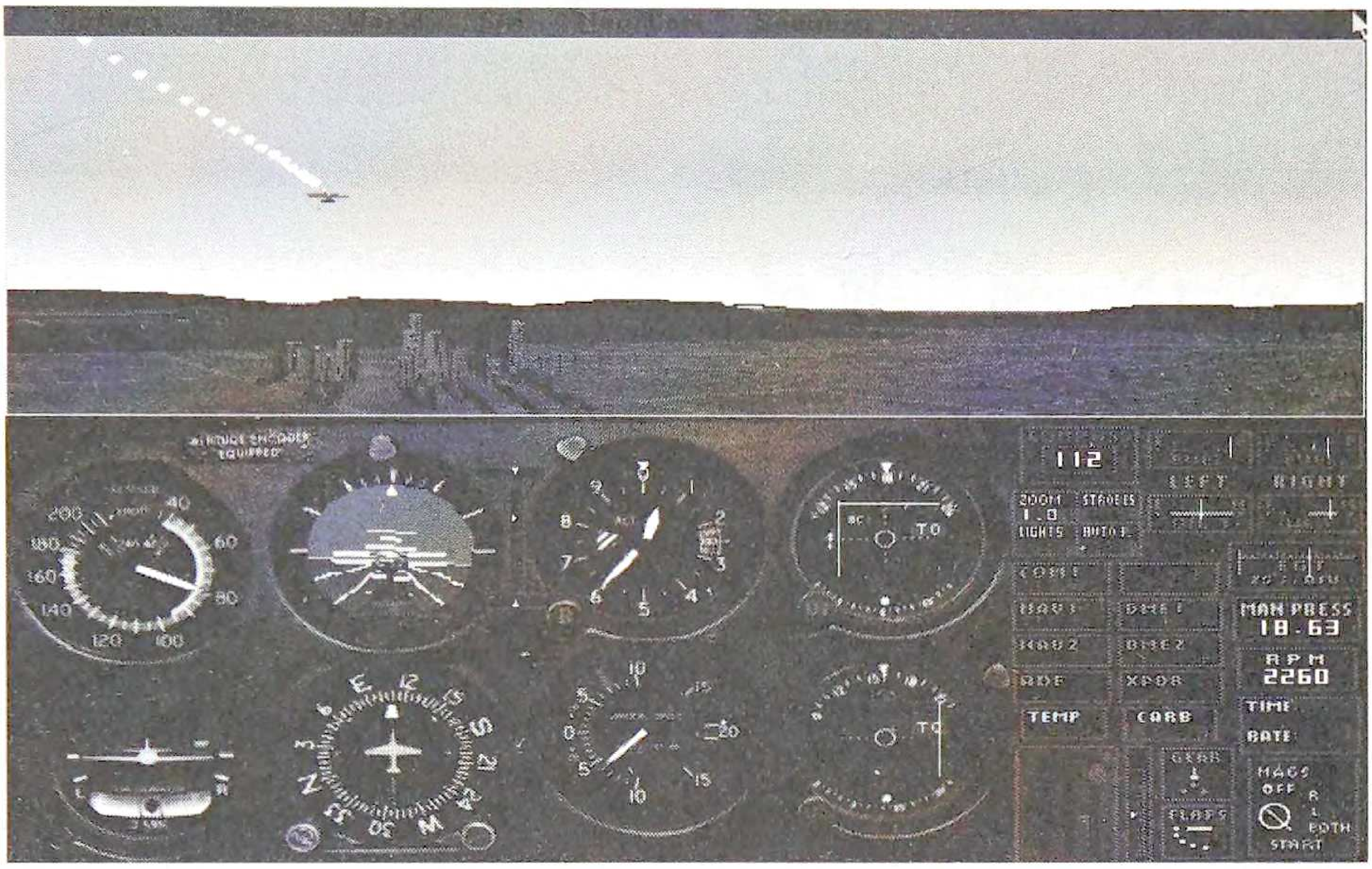

112
ZOOM
1.0
STROBES
LIGHTS
AUTO
LEFT
RIGHT
COM 1
NAV 1
NAV 2
ADF
DME 1
DME 2
XPDR
MAN PRESS
18.63
RPM
2260
TEMP
CARB
TIME
RATE
GEAR
FLAPS
MAGS
OFF
R
L
BOTH
START
TO

FIGURE 16.3: *Following the lead plane*

You can exit formation flying in one of two ways:

- Select Normal Flight, or
- Select Flight Instruction.

Crop Dusting

You can convert the smoke system to a spray system and play a crop dusting game. In the game, you get points for spraying as much as you can in as little time as possible. To play this game:

1. Select the menu bar.
2. Select Options.
3. Select Entertainment.
4. Select Crop Duster.

5. Select OK.
6. Spray the rectangular field to get maximum coverage.

To exit crop dusting, either

- Select Normal Flight, or
- Select Flight Instruction.

Dual-Player Flights

With the Multi-Player option on the Entertainment menu, you can fly with a buddy. In other words, two players, using separate machines, can fly together.

Communication between pilots is accomplished through the COM (serial) port. You can connect two machines together directly with a null modem cable if both planes are in the same room, or through the phone line using modems if the planes are in separate locations.

To practice dual flying:

1. Select the menu bar.
2. Select Options.
3. Select Entertainment.
4. Select Dual Player.

To end a dual player flight, either

- Select Normal Flight, or
- Select Flight Instruction.

Communicating between Airplanes

What good would it be to fly with a friend if you couldn't communicate? Flight Simulator lets you talk to another airplane.

To establish communications between machines:

1. Select the menu bar.
2. Select Options.
3. Select Entertainment.
4. Select Dual Player.
5. Select OK
6. Select Send Message or press 0 on your keyboard.
7. Type your message.
8. Press Enter.
9. Press Escape.

17

Controlling the Simulation

Flight Simulator lets you control many aspects of the flight.

When you are running low on fuel in Flight Simulator, you can gas up in the middle of a flight. This step explains how to do that, and also how to cover up flight instruments to make the dashboard easier to read. You'll also learn how to make limited scenery design changes and change the weather aspects of your scenery.

• • Filling Up the Fuel Tank

To change the level of fuel in each tank:

1. Select the menu bar.
2. Select Sim.
3. Select Engine and Fuel. A dialog box appears.
4. Type in the relevant information.
5. Select OK.

TIP *When you change either the amount of fuel (gallons or liters), the percentage of capacity levels changes as well.*

Covering Up Flight Instruments

NEW ***Version 5 does give you freedom to redesign dashboards, but you can cover instruments to make the dashboard easier to read.***

To cover an instrument:

1. Select the menu bar.
2. Select Views.
3. Select Instrument Panel Options. A dialog box appears.
4. Select Primary Instruments.
5. Select the instrument you want covered.
6. Select Covered from the list box.
7. Select OK.

The following lists show, airplane by airplane, which instruments you can cover up:

Cessna:

Airspeed indicator
Attitude indicator
Altimeter
Heading indicator
Turn coordinator
Vertical speed indicator

Learjet:

Airspeed indicator
Attitude indicator

Altimeter
Heading indicator
Vertical speed indicator

Sailplane:
Airspeed indicator
Altimeter
Vertical speed indicator

Sopwith Camel:
Airspeed indicator
Altimeter

Designing Your Own Scenery

Flight Simulator 5 really is not a design program. However, you can change scenery complexity, change the weather, and even use Version 4 scenery. Scenery controls are found under the Scenery command on the main menu.

Using Version 4 Scenery

If you miss the old and less realistic style of scenery in Version 4, Version 5 will let you choose that style.

To use Version 4 scenery:

1. Select the menu bar.
2. Select Scenery.

3. Select Scenery Library.
4. Select FS4 Scenery disk.

Controlling Scenery Complexity

The second of the Scenery commands covers scenery complexity (the first Scenery command has to do with scenery libraries). You can call up a dialog box with list boxes for changing the complexity of your on-screen images and the patterns of the earth below you.

WARNING ***The more dense the scenery is, the more processing your computer has to do. Dense scenery can slow down the simulation.***

The Scenery Complexity command provides five levels of density:

Very Sparse
Sparse
Normal
Dense
Very Dense

Figure 17.1 shows downtown Chicago with very sparse scenery. Figure 17.2 shows the same downtown area with very dense scenery.

NOTE ***Microsoft also sells extra scenery libraries. You can get libraries for San Francisco, New York, Paris, and other places.***

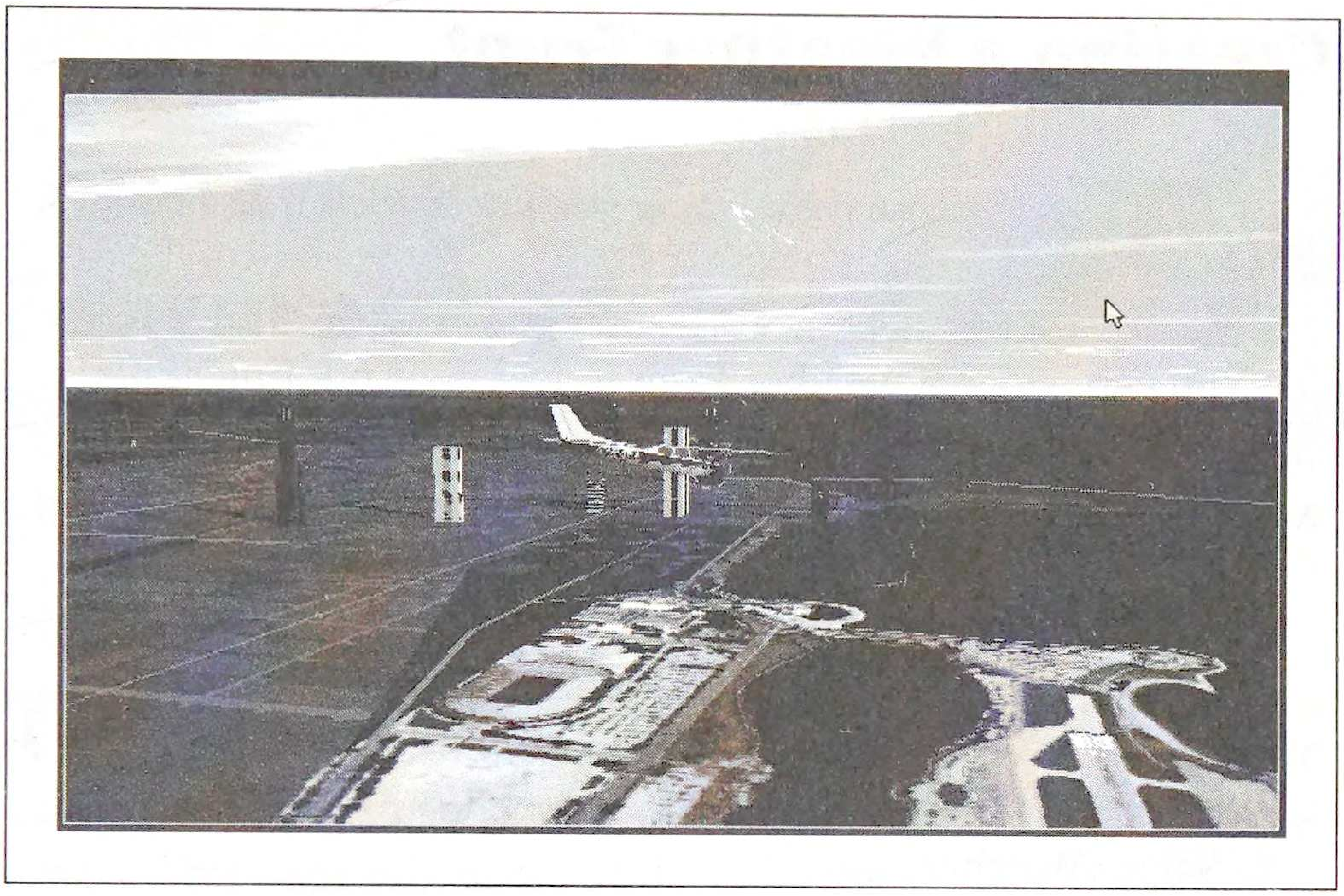


FIGURE 17.1: *Very sparse scenery*

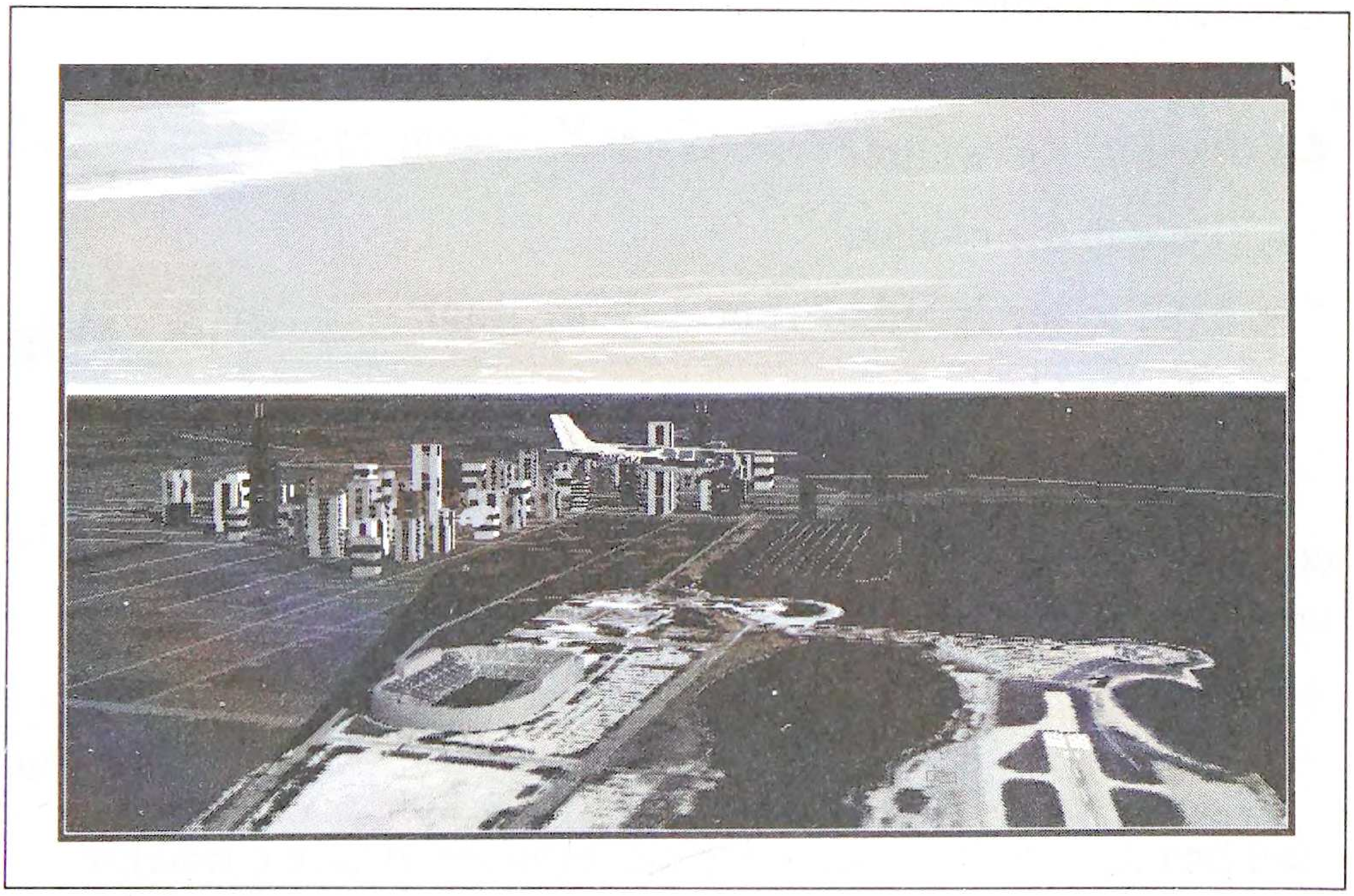


FIGURE 17.2: *Very dense scenery (compare this to Figure 17.1)*

. . . Creating a Weather Front

NEW ***You can create small weather districts with Version 5.***

You can create a weather front to test your piloting skills under various kinds of weather. However, when you create a weather front, it is not static. It will move, and therefore change.

To create a weather front:

1. Select the menu bar.
2. Select World.
3. Select Weather.
4. Select the Add Area button.
5. Type a name in the Name Area box.
6. Type in a longitude and latitude marking.
7. Type in the width.
8. Type in the course.
9. Type in the speed of your weather front.
10. Choose OK.

After you have defined your weather area, you can alter its contents by adding clouds, adding wind, and by changing the barometric pressure and temperature.

A

Features New to Version 5

This appendix is written for users of Version 4 who want to use Version 5. It explains the many differences between the two programs. This appendix does not describe the similarities, however. If a feature is not mentioned in this appendix, you can assume it works the same way in Versions 4 and 5.

New Menu and Keyboard Conventions

NEW *Version 5 uses a new set of menu and keyboard conventions.*

In Version 4 a plus sign (+) appears when a menu item is selected, but in Version 5 a check mark appears.

For menu navigation, numbers are used instead of letters. Instead of pressing a number, you press the underlined letter in the option you want.

Version 5 also introduces check boxes, scroll boxes, and buttons in the dialog boxes in place of numerical commands.

The Esc key no longer returns you to the simulator from an individual menu. Pressing the Spacebar no longer returns you to the simulator from a menu.

New Setup Configurations

You'll notice setup differences as soon as you install Version 5. The very first screen has a list box following the Sound Board command. You can choose a sound board from this list.

You will also see check boxes for Dynamic Scenery and Automatic Weather Generation.

The Version 5 setup also lets you select one of three startup situations:

- Normal Flight
- Normal Time and Date
- Demo

In Version 5, you can have Flight Simulator enter the flight automatically in your logbook. To do this, check the Log Flight Time box.

You can also select if you want to use:

- Joystick 1 (A Off, B Aileron and Elevator); or
- Joystick 2 (C Off, D Throttle and Brakes, E Rudder Only, F Throttle and Rudder).

TIP ***If you change your mind about setup configurations, you don't have to reload Version 5. A simple trip to the General Preferences menu box allows you to make changes after you've started Version 5.***

Graphics and Sound Changes

Version 5 is a much more realistic-looking and sounding system than its predecessor. The instrument panel duplicates the look and feel of a real airplane.

The makers of Flight Simulator have worked hard to accommodate new graphics drivers. The program uses 320×400×256 colors or 640×400×256 colors. Microsoft wrote special drivers for different 640×400 modes. These drivers are specific to various SVGA "chipsets." You need to know the specifications of the chipset on which your card is based, such as ET-4000, when you sign on.

When you crash an airplane with Version 5 you can hear glass shattering. With Version 5, the windshield stays broken when you take off again, unlike Version 4, which came with unofficial miracle mend and kept the windshield in tact.

Scenery Changes

Version 5 also has taken great care to create more realistic scenery. In Version 4, you can choose the Ground Texture Option on the Sim menu to turn the ground to a patchwork of little contrasting squares; Version 5 takes this arrangement one step further. In Version 5, the scenery takes on more depth. Microsoft calls the new arrangement "texture-mapped scenery."

WARNING *You need 1MB of expanded memory configured on your PC in order to see the new texture-mapped scenery. If you don't have expanded memory, you will not see any scenery when you boot your program.*

Version 5 also introduces synthesized scenery to make background buildings look more realistic. The program offers Synth-Berg, a town that demonstrates this technology.

Additional NDBs and VORs

While the program still offers a limited number of airports, you have more VORs and NDBs than ever. Microsoft claims that all the VORs and NDBs in the United States are included and are placed in their exact locations.

The Lat/Long Coordinate System

Purists complained that Flight Simulator 4 had a quirky coordinate system. Why not use the same flying coordinates everyone else in the world uses? Not surprisingly, Version 5's coordinate system has been redesigned and employs the familiar Latitude/Longitude system all navigators use.

Changes to the Menu System

In Version 5 the menu bar has six menus. Reading from left to right, they are Options, Views, World, Sim, Nav/Com, and Scenery.

Like Version 4, Version five has a Views, Sim, and Nav/Com menu. Version 5 has dropped Mode and Enviro and added Options, World, and Scenery. Following is a look at the individual menus in Version 5.

The Options Menu

NEW ***The Preferences, Land Me, Quick Practice, and Simulation Info commands in the Options menu are new to Version 5.***

Options retains many of the old Mode menu commands:

Normal Flight (1 in Mode)
Flight Analysis (2 in Mode)
Entertainment (5 in Mode)
Flight Instruction (3 in Mode)
Instant Replay (G in Mode)

In Version 4, there are five Entertainment choices, but in Version 5 there are only four, because World War I has been dropped. The first four choices, however, are the same except for some cosmetic name changes.

Microsoft decided to retire the World War I game. Although you might suspect the work of politically correct anti-violence saboteurs, the reason for the game's demise was more practical. As one Microsoft official put it, "The game never really worked." However, you can still fly the Sopwith Camel.

The Flight Analysis Menu

With Version 5, check boxes are offered instead of menu choices for Flight Analysis, Landing Analysis, and Course Tracking. When you turn on course tracking, you activate an entire new set of check boxes, including:

Record Course
Display Course
Clear Recorder Course

Track Length (Short, Medium, Long)
Resolution (Fine, Medium, Coarse)

The Flight Instruction Menu

Several subtle changes have been made to the Flight Instructions in Version 5. The basic menu choices are still the same, but with Version 5 you can change to an Advanced or Acrobatic menu by selecting a special list box. The acrobatic lessons in Version 5 are the same as the lessons found in Version 4 when you select W. The advanced lessons include:

Stall With Power Off
Full Stall With Power Off
Full Stall With Power On
Unaccelerated Maneuver Stall
Uncoordinated Stall
Uncoordinated Flight
Slips
Steep Turn
Traffic Patterns
VOR Tracking with Wind

The Instant Replay Menu

In Version 5, check boxes allow you to change the final seconds of instant replay, the replay speed, and the number of times you can replay the instant replay.

Version 4 Mode and Version 5 Options Approximations

You can find many approximations between Version 4 Mode menu commands and their Options menu counterparts in Version 5:

- Review Logbook (5 in Mode) works much the same way as the Logbook command.
- Demo (6 in Mode) does much the same work as the Quick Practice command.
- Quit (7 in Mode) lets you exit much the same way as Exit does.
- Create Mode (C in Mode) is very similar to the Save Situation command.

The Preferences Menu

The Preferences menu, new to Version 5, offers eight choices: General, Display, Sound, Keyboard, Mouse, Joystick, County, and Instrument.

TIP ***If you get lost while navigating one of the dialog boxes that you have selected when you select one of the side buttons, select General. That will take you back to the first dialog Preference box.***

You will want to select Display if you have a SVGA monitor but forgot to tell the program that little fact when you ran Setup. Selecting SVGA 640 × 400 256 color will activate the SVGA Board Maker list box at the bottom of the screen. In short, even if you told the program that you were using SVGA during

Setup, you need to select your board from this list to maximize performance:

V.E.S.A. 1.2

AT1 VGA Wonder +/XL

Video 7

Tseng 4000

Trident 8900

Paradise SVGA

86C911

CirrusLogic 542x

Trident 8900 Alternate

The Preferences menu lets you change the measurement default from feet to meters for those occasions, for example, when you are flying to Germany or France. To change measurement units:

1. Select the menu bar.
2. Select Preferences. The General Preferences dialog box appears.
3. Select Country. A dialog box appears.
4. Make a selection from the list box. You have three choices: U.S. System, Metric system with altitude in feet, and Metric system with altitude in meters.
5. Select OK.

If you are having trouble reading your instruments, you can tell Flight Simulator to make the letters larger:

1. Select Options
2. Select Preferences.

3. Select Instrument
4. Select the list box that now reads Photorealistic.
5. Select Enhanced Readability
6. Select OK.

Quick Practice

The new Quick Practice feature includes:

First Flight Familiarization
Simple Landing Practice
Medium Landing Practice
Difficult Landing Practice

Land Me

Better than an automatic pilot, Land me, a feature new to Version 5, actually guides your plane safely to a runway. To try it:

1. Take off from Meigs Field.
2. Turn your airplane to the right.
3. Select the menu bar.
4. Select Options
5. Select Land me. The airplane should land automatically.

The Views Menu

Although the Views menu in Version 4 and the one in Version 5 both have the same name, they are very different. Map (8 in Version 4) is called Map View. DIREC (4 in Version 4), which controls the airplane views displayed on screen, is now called View Options.

Two features on the Version 5 menu do not appear in the Version 4 menu—Mini Controls and Flight Photograph.

Mini Controls

Mini Controls provides you with the most basic flight control information and allows you to turn off the instrument panel in order to enlarge the viewing window.

The miniature control panel shows:

- the direction of your aircraft
- the level of throttle
- your speed in knots

Mini controls appear in the upper-right corner the window. They look similar to the instruments that appear in the upper-left corner of your screen in Version 4 when you select Control Position Indicator on the Sim menu.

Flight Photograph

The Flight Photograph is a completely new feature that allows you to take snapshots of your flight. To use the Flight Photograph feature:

1. Select Views.
2. Select Flight Photograph. A dialog box appears.
3. Select the area you want to photograph: View 1, View 2, Map View, or the instrument panel.
4. Type a file name to save your photograph under.
5. Select the OK button.

The World Menu

The World menu commands—Slew, Airports, Set Exact Location, Set Time and Season, and Weather—are taken from the Mode, Enviro, and Nav/Com menus in Version 4.

In Version 4, you set season and time by using separate commands on the Enviro menu, but in Version 5 these commands have been combined under the single command Set Time and Season.

The Position Set in Version 4, located on the Nav/Com menu, has been replaced by the Set Exact Location option on the World menu. The key difference between these two commands is that Version 5 uses a standard latitude and longitude coordinate system.

Slew, option 9 in the Version 4 World menu, is the first command in Version 5's World menu.

Setting the Weather

NEW

The Weather menu is much more advanced in Version 5.

In Version 4 you use the Enviro menu to make Clouds (B) and Winds (C) settings. In Version 5, you make cloud and wind settings by choosing the appropriate button when you select the Weather command. After you choose a button, a dialog box called Weather Area appears. Version 5 allows you to define weather zones. Making wind and cloud settings this way is much more realistic. In Version 4, you make weather settings for the whole world—a great idea if you are sailing Noah's Ark but not a realistic setting for most pilots. In addition to setting

Winds and Clouds, Version 5 allows you to set the temperature by choosing the Temp button.

You can create more than one weather zone for any particular flight path. You can also copy an entire weather area. To do this:

1. Select the menu bar.
2. Select World.
3. Select Weather. A dialog box appears.
4. Select the area you want to copy.
5. Verify the area in the Copy From box.
6. Select a destination in the Copy To box.
7. Select OK.

The Sim Menu

Many of the same commands are available from the Version 4 and 5 Sim menu, but they are arranged differently.

Version 5 has added a Simulation Speed option so you can change the speed of the simulation. The Calibrate Altimeter command lets you calibrate your altimeter. The Realism (A in Version 4) and Reliability (B in Version 4) commands have been combined into a single menu option.

In Version 5, these commands have been dropped from the Sim menu:

C Instrument Panel
D Mouse
E Joystick
F Keyboard Sensitivity

In Version 5, you can find these commands under Preferences in the Options menu.

Version 4's Ground Texture (1) has been eliminated.

Crash Detection

The Crash Detection option in Version 5 offers six check boxes:

Ignore Crash
Detect Crash and Reset Situations
Detect Crash and Show Graph
Show Aircraft Damage
Off Runway Crash Realism
Crash When Hit Objects

The Nav/Com Menu

Some features on the Version 5 Nav/Com menu are the same on the Version 4 menu:

Autopilot (6 in Version 4)
EFIS/CFPD Display (8 in Version 4)
Transponder (D in Nav/Com)
ADF (E in Nav/Com)
Air traffic control communications (7 in Version 4)
Nav Radio (B in Version 4)
Com Radio (C in Version 4)

Version 5 has eliminated or relocated:

1 SCENERY
2 SCENERY Library
3 Map Display

4 Map zoom in
5 Map zoom out.
7 Air traffic control communications
A POSITION SET
F AUTOPILOT SET

The scenery library in Version 4 is located on the Scenery menu in Version 5.

The Scenery Menu

The Scenery menu in Version 5 offers only three choices instead of Version 4's five choices. Scenery Disk in A and FS 4.0 Default Scenery have been dropped. The other three choices—Scenery Library, Scenery Complexity, and Dynamic Scenery—are largely the same in both versions.

NOTE ***You can call up Version 4 scenery with the Scenery Library list box in Version 5.***

TIP ***If your PC does not have expanded memory, use Version 4 scenery.***

• • • Exiting

To exit Flight Simulator, you use different techniques in Versions 4 and 5. When you exit in Version 4, a Flight Simulator Shutdown box asks if you are sure you want to exit, and then you select Yes or No.

In Version 5, a dialog box appears informing you that "This will end your Flight Simulator Session." You then select either the OK or the Cancel button.

B

Flight Simulator Add-Ons

This appendix briefly describes the many add-on products available for Flight Simulator. Both commercial add-ons and freeware/shareware add-ons are listed. I would like to thank James Ross (CompuServe 70234,143) for his assistance with this appendix.

Commercial Add-Ons

Many different vendors offer commercial add-ons for Flight Simulator. If you are interested in a commercial product mentioned in this appendix, contact its manufacturer from the following list:

Bruce Artwick Organization, Ltd. (BAO)
P.O. Box 573
Champaign, IL 61824
(217) 356-9799

Datawings
9015 Puritan Way
Rocharon, Texas 77583
(713) 431-1079

Flight Computing
42 Digital Drive #14
Novato, CA 94949
(800) 992-7737

Mallard Software, Inc.
550 Edmonds Street #201
Lewisville, TX 75067
(800) WEB-FEET

SimuTech Corporation
P.O. Box 274112
Tampa, FL 33688
(800) 226-7820

SubLOGIC Corporation
501 Kenyon Road
Champaign, IL 61820
(217) 359-8482

TEKMATE
15307 Parkville
Houston, TX 77068
(713) 440-5542

Aircraft and Adventures Factory by Bruce Artwick Organization and Mallard

AAF allows you to design planes for use with Flight Simulator. This add-on gives you a good deal more flexibility than the aircraft designer in Flight Simulator does. AAF planes can be flown even by users who do not themselves have AAF. The aircraft design module requires Windows 3.0 or later.

The "adventures" part of the program creates scenarios or "scripts" involving Air Traffic Control, sound effects, and other effects. This is a DOS program. To use the "voice" part of the program, you must have Sound Graphics Adapter (see below).

Aircraft & Facilities Directory by TEKMATE and Mallard

AFD places you at different airports. The program also provides preset radio frequencies, headings, altitudes, and flight coordinates.

Aircraft and Scenery Designer by Microsoft and the Bruce Artwick Organization

Some time in the near future, Microsoft will release a new version of ASD that is completely compatible with Flight Simulator Version 5. In the meantime, Microsoft is working on ways to incorporate old release files into Version 5.

Microsoft's Aircraft and Scenery Designer lets you make scenery files that you can "lay over" the default scenery. You can also lay ASD scenery over SubLOGIC scenery disks. When installed, ASD becomes a part of Flight Simulator. You can create runways, roads, mountains, navigational aids (VORs, NDBs, and ILS systems), lines, rivers, polygons, and a great variety of buildings, as well as towers, trees, and automobiles. You can change the color, size, and shape of scenery.

ASD comes with a variety of planes (see Step 7) and includes a plane designer far more powerful and complex than the one provided by Flight Simulator. All ASD scenery files are compatible with Flight Simulator 5.

ASD is available at most software stores and is also sold by Mallard.

Flight Planner by Mallard

Flight Planner is designed especially for use with Flight Simulator. The program comes with databases containing coordinate and navigation information. You can fly between airports either automatically or manually. The program gives you text summaries and graphic plots of routes. Flight Planner comes in both DOS and Windows versions.

FSPRO by from TEKMATE and Mallard

FSPRO was the first Flight Simulator shell. Its primary use is to start Flight Simulator in any mode without having to go through the rather complicated Flight Simulator Mode menu. The program also lets you do rudimentary flight planning and to keep records of aircraft types. Moreover, you can place your airplane in any position in Flight Simulator scenery. In this respect, FSPRO can double for SubLOGIC's New Facilities Locator (see below).

New Facilities Locator by SubLOGIC

The New Facilities Locator (there was an older one, Instant Facilities Locator) lets you go immediately to any airport or VOR on the default scenery, the SubLOGIC scenery disks, or SubLOGIC's Instrument Pilot's Scenery (which contains all of the paved public access airports in the continental US). You can place yourself at any runway threshold, or, in the case of VORs, at any distance and bearing from any threshold. You can also set the ILS frequency.

PROSIM by SimuTech

ProSim is an Audio/Handbook system with the voices of air traffic controllers talking to you, the pilot of a Cessna 51367. The tape leaves time for you to respond and then acknowledges, or gives clearances, headings, altitude assignments, etc.

The Handbook includes both sides of each conversation so you can follow along and learn in-flight procedures. By the time you don't need the handbook anymore, you will have gained a thorough understanding of Air Traffic Control.

Recorded by real pilots and air traffic controllers, and with authentic engine/cockpit sounds, ProSim is a realistic duplication of real flying. Other pilots can be heard on the frequencies.

Rescue 911 by SimuTech and Mallard

If you already have the Aircraft and Adventure Factory, you can add this program, which simulates a fixed-wing ambulance in tough flying. The air traffic controller will give you audio instructions for your mission.

SEE by TEKMATE and Mallard

SEE offers a great many enhancements, changes, and duplications to ASD scenery. Among other things, you can:

- Set the range of any scenery element—that is, the distance from which it will be visible, or, in the case of navigation aids, the distance from which they can be tuned.
- Change the color of certain scenery elements depending on the time of day
- Turn lines into dots so they are visible at dusk and at night.

- Transform roads into a series of dots.
- Add hazard lights so they are visible at dusk and at night. You can also place hazard lights on buildings over a specific height.

With SEE, you can delete objects somewhat more precisely than you can with ASD itself. Furthermore, SEE can export an ASD element from one file and import it into another or the same file, thus making a duplicate element.

A good many SEE "library objects" can be added with SEE itself, including transmission towers, balloons, whales, docks, road signs, rotating beacons, and skid marks.

The latest version of SEE is SEE04. In addition to the features outlined above, SEE04 lets you make new SEE library objects and draw lines and polygons.

Sound Graphics Adapter by BAO and Mallard

SGA provides airplane sound either through your PC Speaker (as usual) or through the following sound boards (which must be purchased separately): AdLib, Sound Blaster, Sound Blaster Pro, ATI Sound F/X, Covox Voice Master, and Thunderboard. With the Sound Blaster cards, you can also get spoken ATIS and COM messages.

Drivers are included for various graphics cards, such as the Video7 1024i, two ATI Wonder cards, and any Super VGA card with the Tseng 4000 chipset. SGA 1.5 has drivers for Paradise and Trident. With these drivers, you get a 800×600 resolution Enhanced Instrument Panel and a 640×480 747 "Glass Cockpit" panel.

Four new aircraft are included: the Concorde, P-51D, Spectrum Beaver Ultralight, and a 1939 Laird-Turner Meteor.

Shareware/Freeware Add-Ons

If you download shareware and find it useful, be sure to send the author a registration fee (most fees are quite modest). Paying the registration ensures that people continue writing such neat programs!

The following shareware and freeware are available from CompuServe's Flight Simulator Forum.

NOTE ***At the time of the writing of this book, all of the shareware listed here was oriented towards Version 4 and ASD. We have eliminated all Version 4-oriented software but are keeping the ASD files. You would be wise to check the forum for updates.***

General Flight Simulator Utilities

DEMITOR By Laemming Wheeler

DEMITOR is an editor for Flight Simulator demos. It allows you to add comments, change views, and zoom in and out, among other things, to enhance your original demos. Included is a utility for attaching a startup mode to a demo.

FS4BFN.ARC by Ray Cannon

This program provides various fixes for the Flight Simulator Multi-Player mode. However, some of these fixes are incompatible with SGA.

Navigator (NAV45.ZIP)

This is an English-language version of a German, commercial Flight Simulator 4 add-on. It generates random weather reports and transfers all data to Flight Simulator. It includes a flight planning module, as well as ready-to-go flight logs.

• • • ASD Utilities

APTFIX.ZIP by Chris Manrique

Use this program when designing an airport on the site of an airport provided by a SubLOGIC scenery disk to eliminate the old runways so that they will not interfere with new ones.

ASDMOVE.ZIP by Steve Wigginton

ASDMOVE allows you to move a whole block of ASD elements from one part of the scenery file to another. It also allows you to save a scenery element in one file and add it to another one. You can also delete a whole group of objects from a file and rearrange them.

BIGLIT by Jim Ross

BIGLIT allows you to expand or reduce any ASD object (except navigational aids and runways). When you expand an object, you can change the range of visibility as well. Expansion factors are 4, 16, 64, and 256; reduction factors are 4, 16, and 64.

LEVITILT.ZIP by Jim Ross

LEVITILT will levitate—that is, raise above ground level—any ASD scenery element specified by the user. The program can also tilt, pitch, or bank most buildings. Use this program to raise the lines that run between towers to produce power lines, make roads that go over the tops of mountains, and do things of that sort.

MERGER.ZIP by Jim Ross

This program merges several ASD .SC1 files and gives them the proper overlap.

OVERLAP.ZIP by Jim Ross

This program determines the boundaries of ASD scenery files (.SC1) to ascertain the overlap and "dead space" between files.

SA.ZIP by Frank Styron

SA is a utility for reducing the size of runways on SubLOGIC scenery disks SD 1 through 6 to their correct size. As necessary, the program moves runways to maintain the original airport layout.

SC1DUP.ZIP by Peter Dowson

This program lets you delete duplicate objects in ASD .SC1 files.

SC1FPD.ZIP by Peter Burri

This program creates .FPD files for use with Flight Planner from any ASD .SC1 file.

SCMAN.ZIP by Christopher Trent

SCMAN.ZIP is a set of tools for adding and deleting scenery files for the Flight Simulator 4 ASD utility. All run from the DOS command line. It places a small working set of scenery files (.SC1, .DY1, .MOD) in the main working directory and all others in a set of subdirectories.

Demos

LVKOAK.DEM by Charles Gulick

You can find various demos in the Flight Simulator forum libraries. The best one, however, is probably LVKOAK.DEM, a complete Flight Simulator 4 demo from takeoff to landing. The program is full of useful tips.

Final Approach Plates

This windows-based graphics program allows users to design, view, and print real-world instrument approach charts for use with Flight Simulator and other simulators as well. Don Simmons and Georges Lorsche have uploaded several of these charts, including:

- IAP001.zip, twenty plates covering JFK, Montreal, and other airports
- IAP002.zip, Frankfurt airport
- IAP003.zip, Ft. Lauderdale airport

C

Resources

This appendix lists resources for the Flight Simulator user, including forums, bulletin boards, and publications.

• • Forums

America Online has an Aviation Club. You'll find it under the Lifestyles and Hobbies section. America Online's Aviation Club provides information on both computer and noncomputer flights.

CompuServe, on the other hand, has a complete Flight Simulator forum covering Microsoft Flight Simulator as well as numerous other products. CompuServe also features live conferences. If you join, please tell Jim Ross and everyone else "hello" for me.

The CompuServe libraries, by the way, are an exceptional source for shareware and freeware. The libraries also provide general-purpose flight tips. Sixteen libraries are available:

1. General/Help
2. General Aviation
3. Air Transport

4. Air Traffic Control
5. Aircraft/Adventures
6. Scenery Design
7. Historic Air Combat
8. Modern Air Combat
9. Space Combat
10. Other Flight Sims
11. Flight Instruction
13. Hardware
14. Fly-Ins and Rallies
15. MICROWINGS
16. Hangar Talk

Most Microsoft Flight Simulator information can be found in libraries 2, 6, and 11.

• • • Bulletin Boards

Mallard offers a 24-hour bulletin board offering information about its products, technical advice, and live conferences. The number for 9600-baud modems is (214) 436-4896. The number for 2400-baud modems is (214) 436-7493.

You can also pick up information on Flight Simulator from the Microsoft Support BBS at (206) 936-6735.

Table C.1 lists bulletin boards with information about Flight Simulator and other aviation simulators.

NAME	TELEPHONE NUMBER	SYSTEM OPERATOR
The 32 Bit Bus	(215) 741-9893	Bob Bernstein
ATIS	(703) 242-3520	William Downing
The Coffee Shop	(407) 830-5316	Jim Murphey
Flight 642	(416) 642-2993	Bruce Forbes
Flight Service	(407) 684-6963	Bill Hoensteine
The Flying Machine	(517) 536-5263	Chuck Sheldon
Jim's Fly-In BBS	(312) 882-1142	James Williams
The Megabyte Mansion	(402) 551-8681	Todd Robbins
Power Windows!	(205) 881-8619	Cyrus Theaty
Treasures BBS	(407) 831-9130	Jim Daly
Xevious	(508) 875-3618	Nels Anderson

TABLE C.1: *Flight Simulator Bulletin Boards*

Magazines

MicroWINGS is the most prominent magazine dedicated to flight simulators. The magazine also sponsors a BBS, provides access to an international database for modem flying, and sponsors an annual conference.

For more information, contact:

MicroWINGS
381 Casa Linda Plaza #154
Dallas, Texas 75218
(214) 324-1406

D

Glossary of Flight Terms

accelerated maneuver stall A stall brought about by an abrupt changes in flight paths.

active runway The runway currently in use at a large airport. Because of traffic concerns, it is usually impractical to allow more than one plane to take off or land at the same time.

ailerons The surfaces on the outside trailing edges of the wings that control how the plane rolls.

airfoil In aerodynamics, a term describing a surface or body, such as a wing, designed to obtain a reaction, such as lift or thrust.

airspace The air around a given area, such as a city, airport, or country.

airspeed indicator The indicator on the dashboard that displays the aircraft's present speed.

altimeter The measurement indicator that displays the aircraft's altitude. Most altimeters are known as ***pressure altimeters*** because, as part of measuring the altitude, they measure the drop in pressure as the aircraft climbs.

angle of attack The acute angle between the wing's chord line and the relative wind.

artificial horizon The indicator on the dashboard that displays the attitude of the aircraft with respect to the ground. It is used when the true horizon cannot be seen.

aspect ratio The ratio between the wing span and the mean chord of the wings.

Air Traffic Control (ATC) The ground-based radio network responsible for assisting pilots in the take off and landing of their aircraft.

Automatic Terminal Information Service (ATIS) A continuous-loop recording, usually updated on the hour, played over a specified frequency giving weather and other vital information for an airfield.

atmospheric pressure Pressure exerted by the air. Typical air pressure at sea level is between 28 and 32 inches of mercury. Also known as ***barometric pressure***.

auto-coordinated Refers to the connection between the rudder and ailerons that instantly moves one as the pilot moves the other.

bleed off A process where a given parameter, such as altitude or speed, is slowly decreased in a carefully controlled manner.

canted gyroscope A gyroscope within a flight instrument, usually the turning coordinator, with a rotational axis that is tilted, or canted, with the aircraft's longitudinal axis.

ceiling The altitude with the lowest broken or overcast cloud layer.

chord A wing measurement, from the leading edge to the trailing edge.

COM Short for "communication," usually the communication radio.

control yoke The control wheel and connections by which the ailerons and elevators are manipulated.

dead reckoning Navigation of an airplane exclusively by calculations based on factors such as airspeed, course, heading, and wind direction.

density altitude Air density at a given altitude expressed in relationship to the standard atmosphere (surface temperature 59 degrees and pressure 29.92 inches at sea level).

dihedral The angle, if any, at which the wings are tilted upward.

directional gyro A heading indicator.

distance measuring equipment (DME) The radio used to determine an airplane's distance from a VOR.

drag The aerodynamic forces that oppose the movement of an aircraft through the air.

elevators The control surfaces on the trailing edge of the horizontal stabilizer. They control the aircraft's pitch.

flaps The movable airfoil sections on the trailing edge of the wings.

flare The last part of a landing approach, where the pilot raises the nose of the aircraft a foot or two above the runway prior to landing.

ground speed As opposed to knots, an aircraft's actual speed when compared to speeds on the ground.

heading The direction in which the aircraft is pointed, but not necessarily the direction the plane is traveling.

heading indicator The directional gyroscope compass that provides information on the direction an airplane is pointed.

horizontal stabilizer The surface that helps to control pitch by providing stabilization along the aircraft's lateral axis.

Instrument Flight Rules (IFR) The procedures governing flight in instrument meteorological conditions (IMC) and high altitudes.

Instrument Landing System (ILS) A system that provides a three-dimensional in-the-cockpit reference for landing. The system consists of radio transmitters and receivers, as well as special flight rules.

Instrument Meteorological Conditions (IMC) Weather conditions that necessitate flight under Instrument Flight Rules (IFR).

isogonic lines Lines of equal magnetic variation of true north from magnetic north. True and magnetic north are a few degrees distant, depending on where the magnetic reading is taken.

knots Nautical miles per hour.

landing gear Equipment, such as wheels and struts, that the aircraft uses to land and maneuver on the ground.

lateral axis An imaginary line going from side to side through the wings.

lift The upward force on the aircraft.

longitudinal axis An imaginary line going from the front to the rear of an aircraft and through its center of gravity.

magnetic variation The angle of variation between magnetic north and true north.

maneuvering speed The threshold speed above which full control surface deflection could create excessive G forces, possibly damaging an aircraft's structure.

NAV Refers to the navigational radio on an aircraft.

NAV-COM Radio combining the functions of a navigational and communication radio.

nose over To pitch forward. This often results when the plane's lift is behind the center of gravity.

omni-bearing indicator (OBI) The indicator that provides information about an aircraft's position with reference to the tuned VOR station.

pilotage Refers to flying cross-country, from one visible landmark to another, using only a flight chart.

pitch The movement of the aircraft about its lateral axis (nose up or nose down).

power glide A long, shallow approach in which engine power is used to maintain the glide.

radials The directional beams radiating from a VOR station.

radio stack The area in the cockpit where the NAV, COM, and the transponder are installed, usually one on top of the other.

rate of climb The rate at which an aircraft is ascending.

rate of climb indicator The indicator that provides information on the rate of increase or decrease in an aircraft's altitude. Also known as a vertical speed indicator (VSI) or vertical velocity indicator (VVI).

roll Movement around an aircraft's longitudinal (or roll) axis.

rotation Pulling back the control yoke to raise the nose off the ground.

rotation speed The speed at which the pilot must pull back on the control yoke to begin rotation during takeoff.

rudder The control surface, mounted on the trailing edge of the tail. The rudder controls yaw.

running lights The anti-collision light system found on most aircraft. The system includes flashing or rotating beacon position lights, a red light on the left wingtip, a green light on the right, and a white light on the tail.

sink rate Negative vertical velocity.

skid The sideways slide of an aircraft away from the center of a curve while turning.

slip The sideways motion of an aircraft while turning.

standard pressure The level of pressure (29.92 inches of mercury) to which an airplane is calibrated when flying at an altitude above 17,999 feet.

very high frequency omindirectional range (VOR) radio A ground-based radio transmitter that provides positive guidance on a pilot-selected magnetic course.

yaw Refers to rotation about the aircraft's vertical (up and down) axis.

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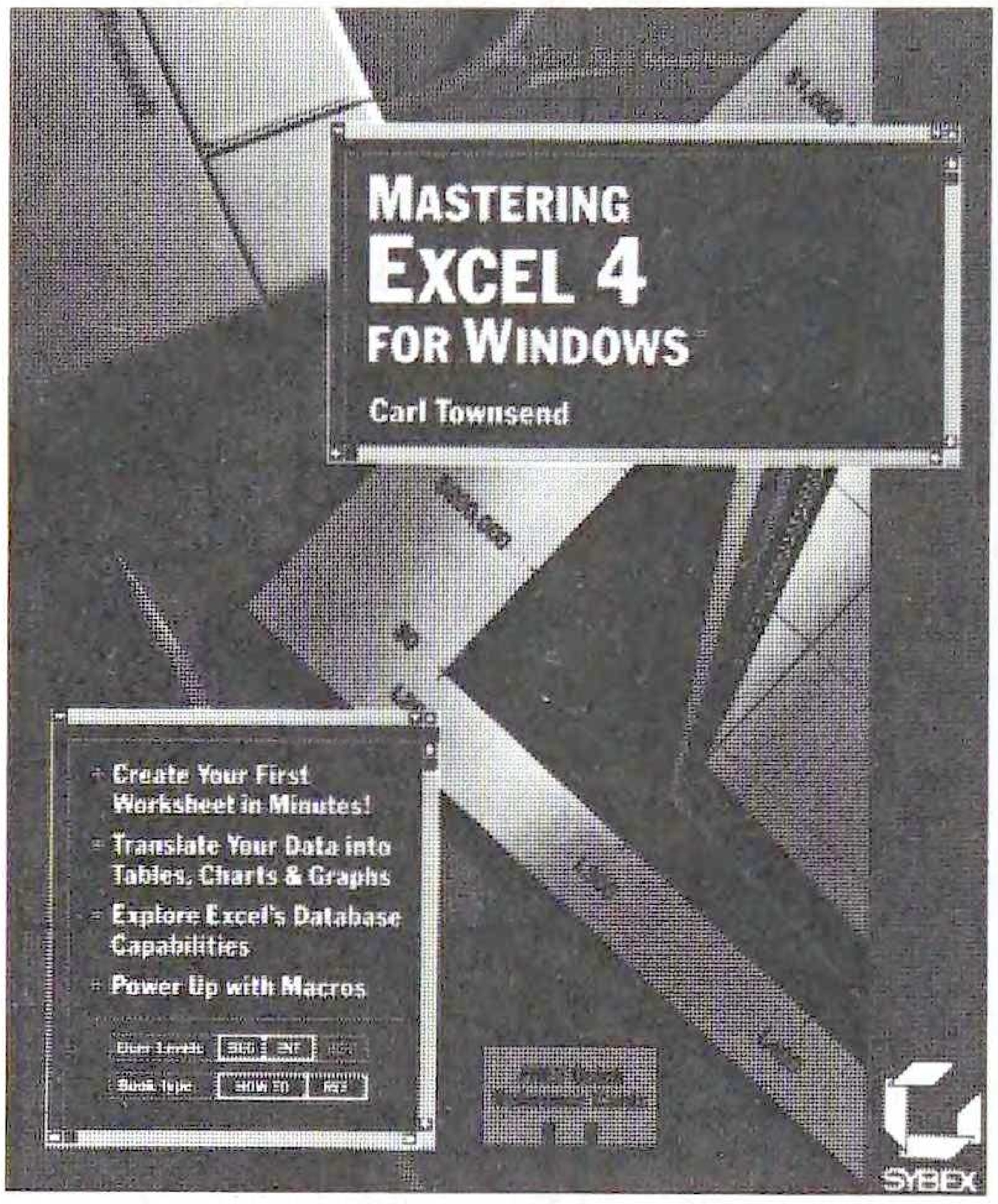
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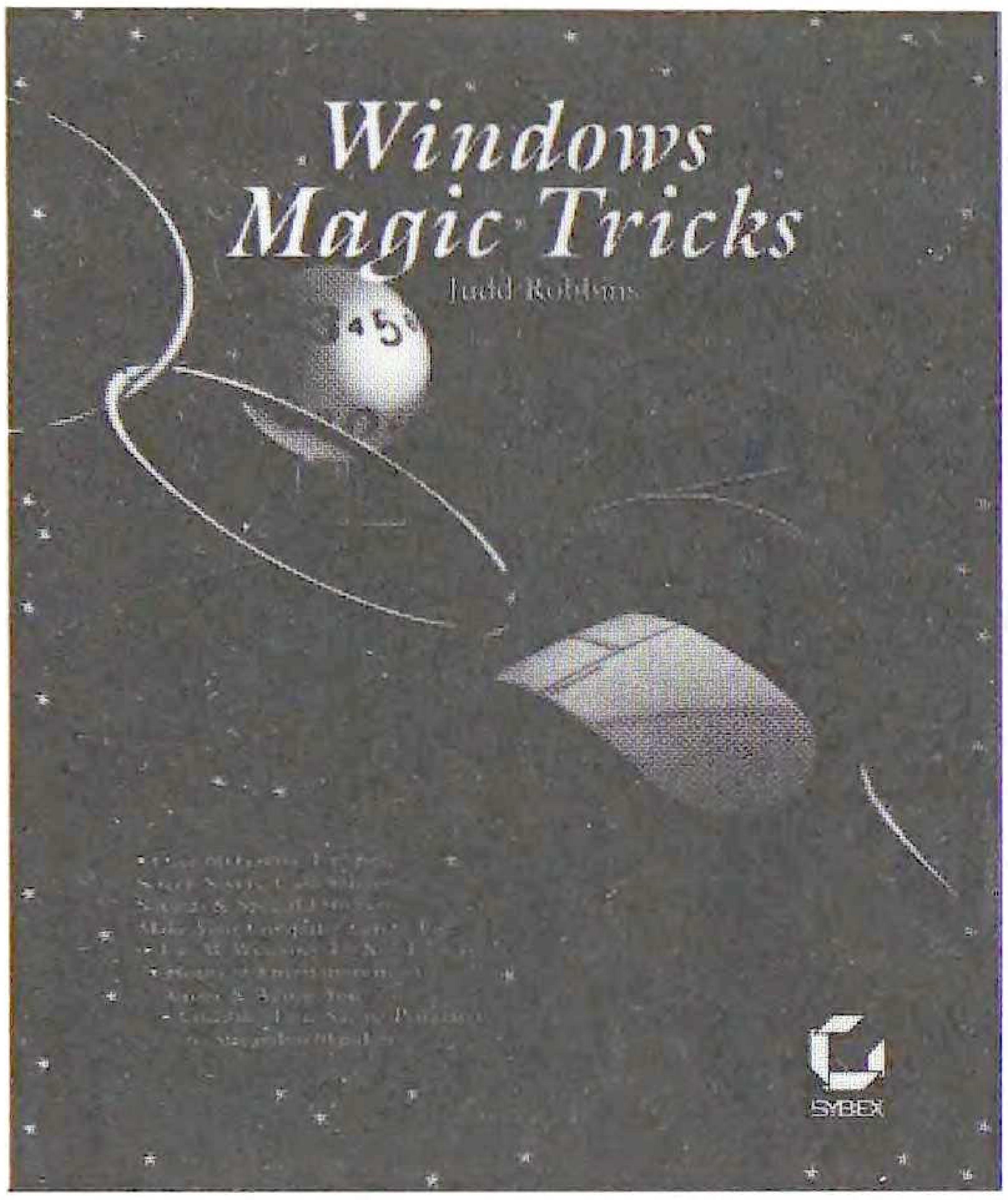

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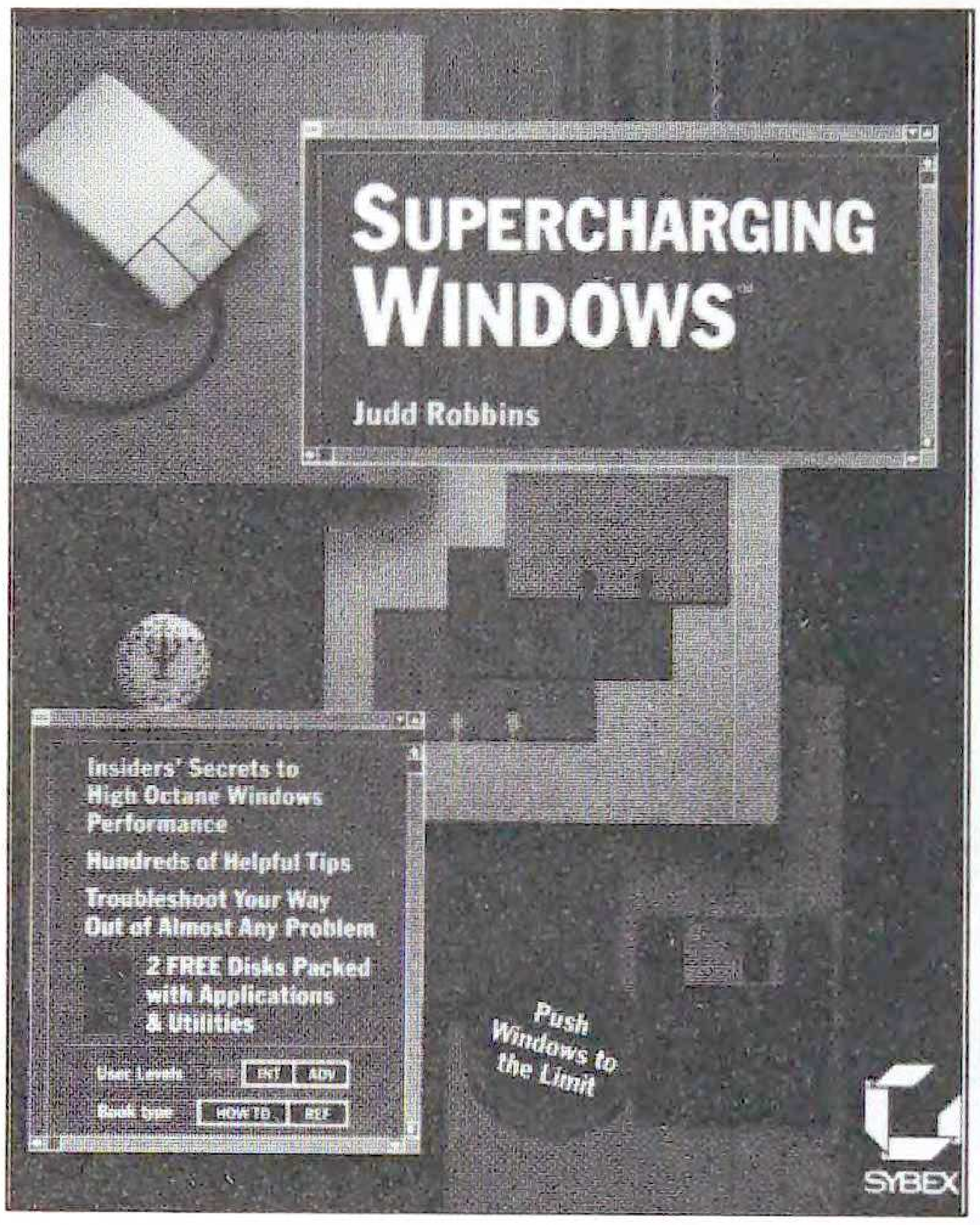
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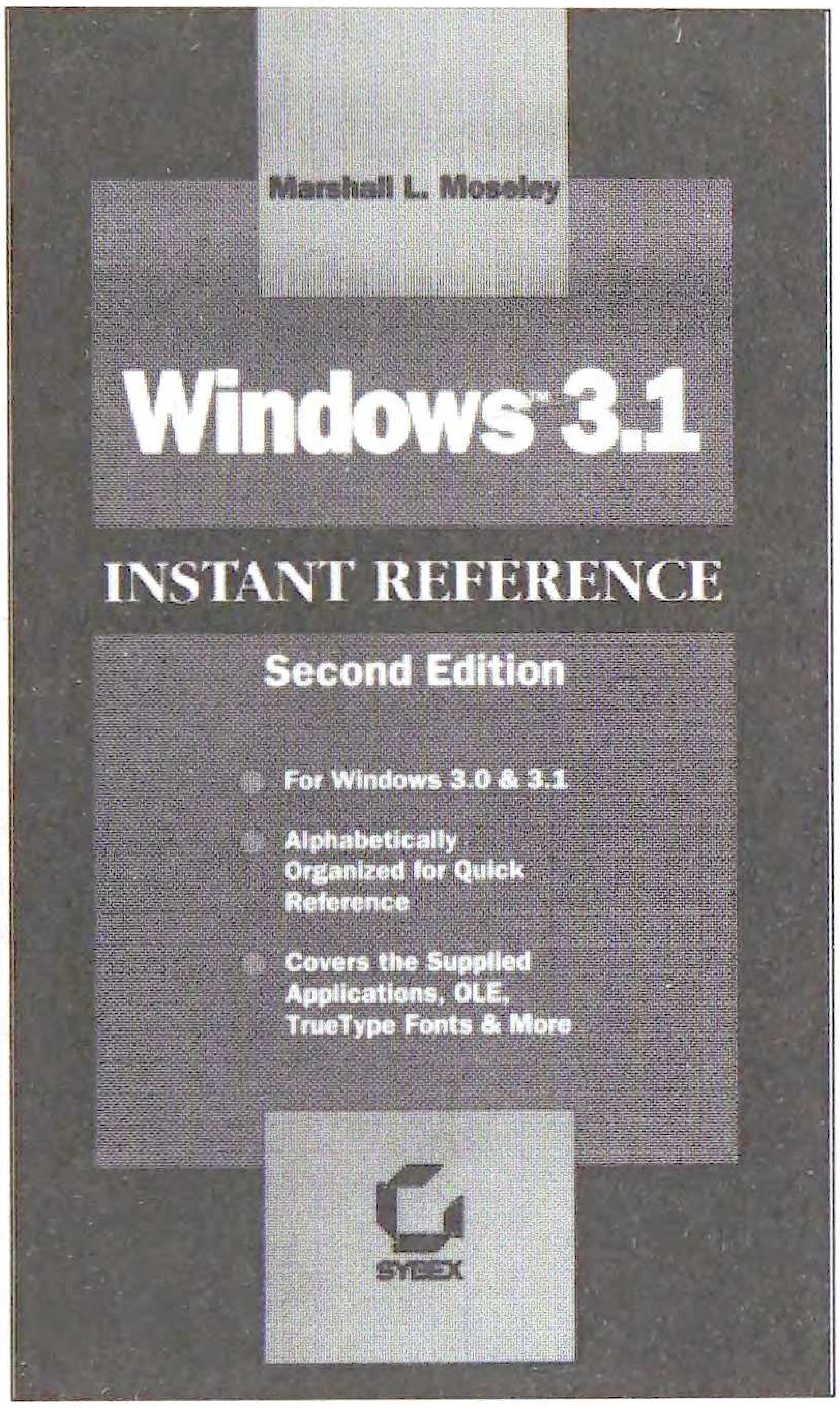
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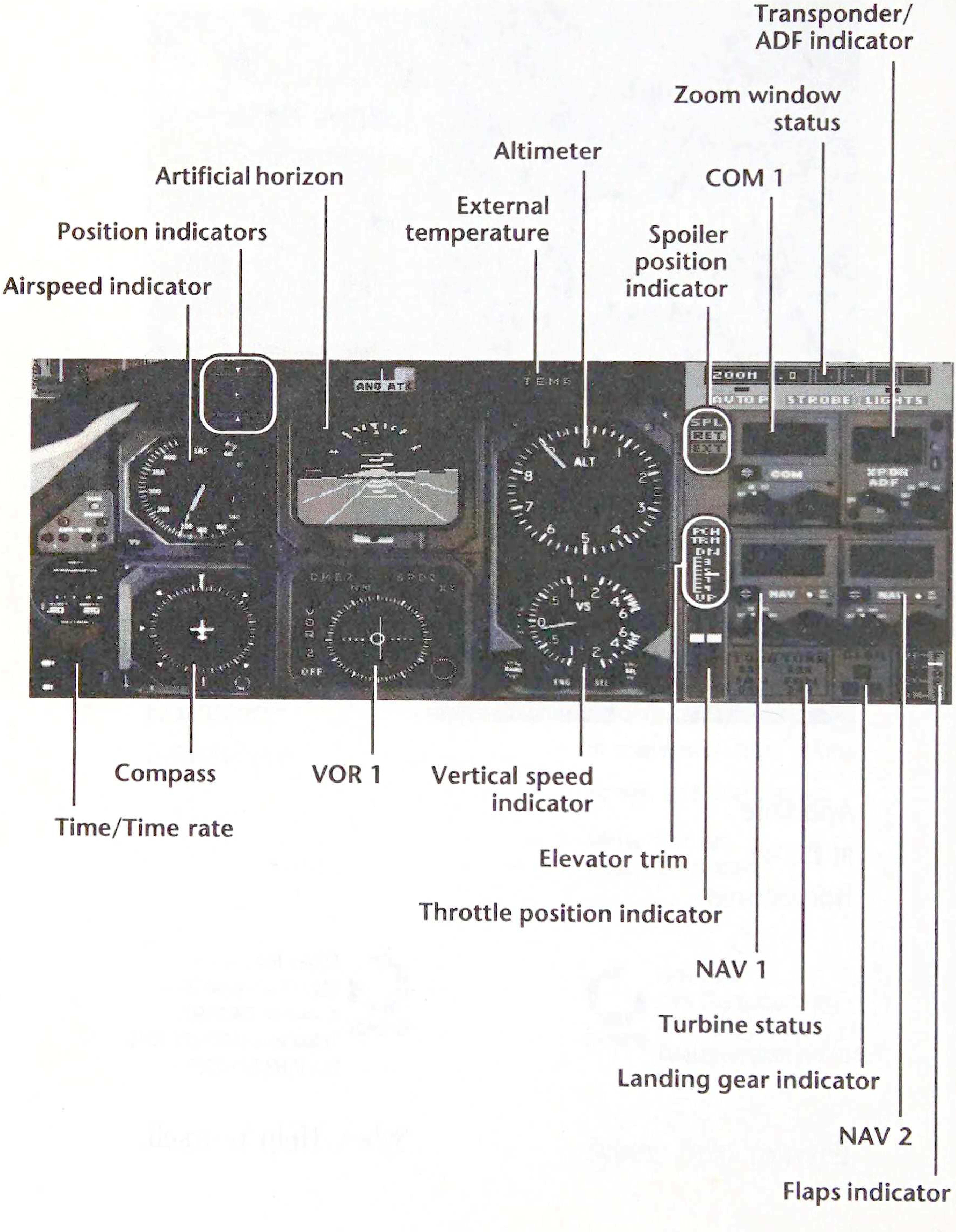
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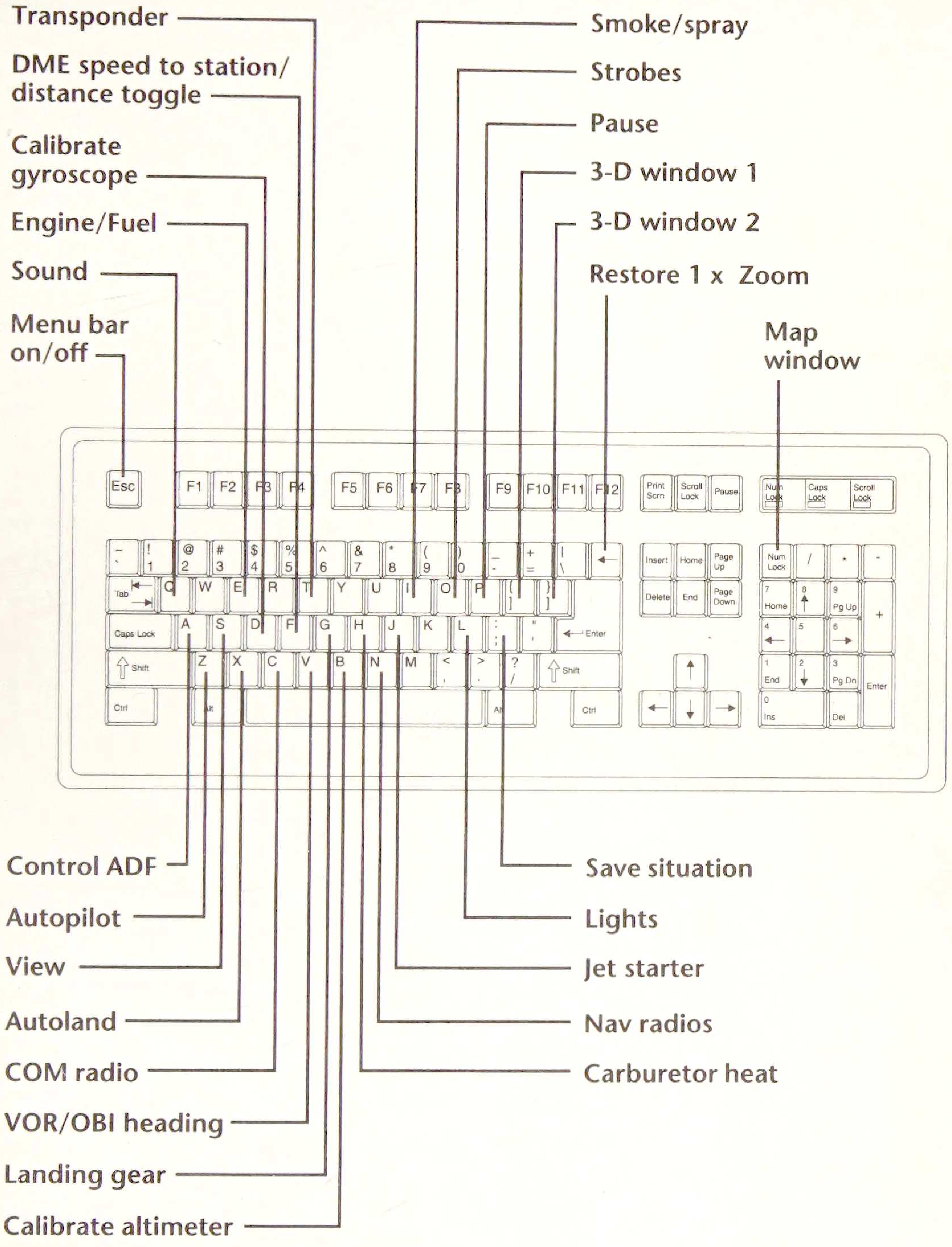
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